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From Industry to University

IT HAS been a frequent complaint of universities that they were unable to attract and hold men of distinction on their scientific and engineering faculties because industry made such attractive bids for their services as to be irresistible. Hence, an exodus from university to industry of such proportions as to alarm those who see in the teaching of science and engineering the very groundwork of our industrial structure. Indeed so great has been the apprehension lest scientific research languish and decline that a movement has been initiated to raise an endowment fund to supplement professorial salaries and research budgets.

IN THE face of these conditions any movement in the opposite direction—from industry to university—is of more than passing importance. Although ardently to be desired, it was scarcely to be predicted at this time. And yet the current school year opens with a notable migration of able men from industrial to professorial pursuits. At least five universities in as many different states will profit by this influx of talent and ability, adding to their prestige, broadening the scope of their work, and insuring a better trained product.

PENNSYLVANIA State College has drawn on the research laboratory of the General Electric Co. for Dr. Wheeler P. Davey to serve as professor of physical chemistry. The U. S. Industrial Alcohol Co. has lost its director of research, Dr. Donald B. Keyes, to the University of Illinois, where he will hold the chair of industrial chemistry. Dr. Richard B. Moore has resigned as general manager of the Dorr Co. and will be head of the department of chemistry and dean of science at Purdue University. Edward P. Mathewson, long a metallurgist of note, has joined the faculty of the University of Arizona as professor of mining administration. And, finally, the University of Minnesota has drafted from the Fixed Nitrogen Research Laboratory its assistant director, Dr. S. C. Lind, and placed him in the directorship of the school of chemistry.

THE quality of talent represented in this group is indicated by the honors and distinction that some of them have already achieved. Moore is a Perkin medalist, the award being based on his work in radium and helium production. Lind has received the Nichols medal for his contributions to scientific literature. Mathewson, for his achievements in copper metallurgy, has been honored with the gold medals of the Institution of Mining and Metallurgy (London) and the Mining and Metallurgical Society of America.

IT IS impossible to estimate the immediate and potential value of these changes. Industry loses, of course, but technical education gains in mature ability rounded out by contact with industrial realities. That science and engineering will thus have a greater ultimate influence for good on industry cannot be doubted. This flow of men between industry and education must also be a powerful factor in correlating and meeting the needs of each field of labor, as well as developing a sympathetic appreciation in each for the importance and value of the other.

Saints of Science

IN the inspiring story of his progress "From Immigrant to Inventor," Michael Pupin pays grateful homage to the eminent physicists who exerted so profound an influence on his life and work. Faraday, Maxwell, Tyndall, Helmholz and Hertz became enshrined in his heart as "saints of science," to use the phrase so aptly coined by his devout mother. And Pupin in his practical idealism, calls upon scientists of all classes to honor and revere the memory of their great leaders and pioneers who blazed trails that now seem clear and unobstructed.

It was in this spirit that members of the American Chemical Society made a pilgrimage to the grave and home of Joseph Priestley at Northumberland, Pa., on Sunday, September 5. There they were reminded of the prodigious labors of that religious liberal and pioneer in chemistry. There they recalled his discovery and identification of oxygen and other gases, made during the historical period of "pneumatic chemistry." There they saw the relics of the experimenter, safely preserved in a fireproof museum erected as part of the activities of the G. G. Pond Memorial Association in preserving Priestley's home and laboratory. And there they heard the hope expressed that some one might be found who would like to continue research and investigation in the remodeled laboratory of Priestley amid the quiet surroundings of a country home built and occupied by one of the great figures in chemistry.

There are but few such occasions to be celebrated by chemists in this country. Only the lapse of time can enrich a people in shrines commemorating the lives and works of eminent pioneers and leaders. Too often, likewise, the passage of time dims the memory of these great figures and allows their homes and personal effects to fall into decay and even destruction. In the present instance American chemistry is indebted to Dean Pond and alumni of Pennsylvania State College for the rescue of the Priestley home from destruction, and to the American Chemical Society for establishing the Priestley medal lecture to commemorate his name.

Dollar Supremacy and the National Defense

IT IS a regrettable fact that the Army and Navy Departments have been severely hampered by inadequate appropriations. Since the war there has been practically no new construction at the government arsenals and other military establishments, and even necessary maintenance and repair have been dangerously slighted. That Congress alone should not be held responsible for such conditions, however, is becoming more and more evident. Somewhere within the departments themselves there seems to have been a conspicuous lack of courage in placing these important matters before the budgetary authorities.

Has the policy of Dollar Supremacy dominated the Army and Navy Departments to the extent that it is stifling progress and development? Such a condition is hinted in the remarks which Major-General Hines is quoted to have made recently in welcoming a new class of army officers to the War College in Washington. "In most respects," he said, "our peace organization has been the result of compromise between military expediency and cost, with cost usually in the rôle of dictator. Therefore, before you make recommendations for a change in our peace structure I would advise that you consider limitations imposed by appropriations and be sure that you fully understand the procedure involved in the operation of the budget system."

To be sure, the remarks of the General were made in explanation of the War Department's attempt to restore to some extent its materiel reserve at the expense of a reduction by 1,385 of the total number of noncommissioned officers and specialists. But these remarks are just as pertinent in explaining the departmental attitude toward other essential expenditures, for example, the correction of faulty practice in the storage of explosives. The Navy disaster at Lake Denmark was one of the unfortunate consequences of this niggardly attitude. The one reason the vicious conditions existing there were not corrected is that it required money to do it and the Naval authorities had not been able to get the money from Congress. Perhaps they had not even asked for it, but, because they had failed to get money for the purposes which they considered more pressing, they concluded that it was not available. Accepting the edicts of false economy under such circumstances, however, borders closely on criminal negligence.

When the new Congress meets in December the appropriate committees of the Senate and House will doubtless be called upon to investigate various phases of the administration of the Army and Navy Departments. Conditions existing at certain of the military establishments will have to be corrected and measures taken that will prevent the recurrence of such disasters as that at Lake Denmark. But the solution of the remaining problem must come from within. Public confidence in the administration of these departments will be restored only when it is certain that sound judgment has displaced the supremacy of the dollar in dictating our policies of national defense.

The Outlook for Domestic Rubber

ONE of the high lights of the Rubber Division proceedings held in Philadelphia, September 9 and 10 as part of the Fall meeting of the American Chemical Society, was the encouraging report of progress on guayule rubber.

From 1904, when the first commercial quantities of guayule rubber were compounded by the Diamond Rubber Co., until recently, little serious attention has been accorded this hardy shrub. But steadily and quietly botanical, physical and chemical research has progressed until now a guayule industry of large proportions seems assured. Behind this prediction is a quarter century of painstaking botanical research during which time "the shrub was put through a regular course in eugenics" as one speaker remarked. Accordingly, an extremely sophisticated product should result; but only lately have efforts to grow big plants with high rubber content been in a large measure successful.

An impressive fact, stated by W. B. McCallum, botanist of the Intercontinental Rubber Co., is that the new guayule shrub, because of its comparatively high rubber content, actually will produce as much rubber per acre per year as hevea trees. Furthermore, the shrub is indigenous to large areas in our own Southwest and will yield rubber much more quickly than will trees.

The work of David Spence, vice-president of the Intercontinental Rubber Co., shows that both physically and chemically guayule is comparable to hevea rubber. Tensile and elongation characteristics of compounds from the two raw rubbers are practically equivalent. In any agricultural or mechanical process in which the units are small, the cost factors must be scrutinized carefully. The guayule producers have not overlooked this principle and many ingenious labor-saving devices have been developed from the planting of the seeds to the harvesting of the shrub and extraction of the rubber.

Without question the outlook for a substantial production of domestic rubber is reasonably bright. At least intensive research and development of the guayule shrub has something tangible to its credit—a high-grade raw stock at reasonable cost—which is far more than can be said of any synthetic rubber, past, present or in sight.

International Aspects of the Fertilizer Situation

WORLD politics and imaginative chemistry proved strange bed fellows last month at Williamstown and their relation to each other was not made any clearer by the sensational outgivings that appeared in the public press. The same Institute of Politics gave serious attention to one industry, however, that is very definitely concerned with international developments.

As Charles H. MacDowell, the able chairman of the round table on mineral resources, pointed out, the world situation in potash, phosphorus, sulphur and nitrogen not only affects fertilizer manufacture but also illustrates the interdependence of nations in securing the basic raw materials needed to grow larger field crops. A nation's future food supply, and therefore its self-preservation, can be measured in terms of these four elements. But the discussion at Williamstown had a more immediate and practical significance. Well versed authorities reviewed the developments in each of the four fields and interpreted their bearing on the fertilizer industry.

The recent Franco-German agreement for potash was characterized by a representative of the U. S. Department of Commerce as the most unique document in the history of international industrial relations. One of the signatories is a state and the other an industry under complete control of the German Government. Together they act as a monopolistic unit in control of an essential raw material and arbitrarily divide the American market on a percentage basis. The price thus set is the price the American consumer must pay.

Phosphorus has appeared less conspicuously in the international limelight, for our large deposits have not only taken care of the domestic demand but have provided a profitable balance for export. But lately Morocco has found a ready market in Europe for her rapidly increasing output of phosphate rock. High trans-Atlantic freight rates and comparatively low wages in the North African fields have combined to threaten the export trade of the American phosphate producer. The end is already in sight unless a practical means is shortly developed for producing phosphoric acid from low-grade rock.

Sulphur, in the form of pyrites, may again become a considerable factor in our import trade. The tremendous deposits in Southwestern Spain are capable of supplying raw material for sulphuric acid manufacture for many generations to come. Elemental sulphur is our preferred raw material in this country as indicated by the estimate that 4,810,000 tons of sulphuric acid out of total of 6,850,000 was produced from this material in 1925. But the time may come when a reversion to pyrites is desirable from the standpoint of immediate cost as well as of conservation of a valuable mineral resource.

Down to Fundamentals in the Dye Industry

C. G. DERICK has a reputation for saying what he thinks and also for thinking along lines that sometimes lead abruptly away from the conventional channels of technology. His audience at the meeting last week of the Dye Division of the A.C.S., was not surprised, therefore, that his address on "The Importance of Research in the Dye Industry" was considerably more sparkling than his somewhat drab title might imply.

Such organic chemicals as dyes are primarily the products of the human mind when acted upon by physical environment. As Dr. Derick pointed out, only a very few of them ever occur in Nature. The dye industry in the last analysis is the concrete result of the atomic linkage theory enunciated by Kekulé and Cooper. In the words of Professor Reid of Johns Hopkins, this has been a sort of Magellan chart that dye chemists have always followed. It would have taken millions of years if we had had to wait until enough Perkinses had come along to pour enough solutions together to discover enough dyes to meet present-day demands. But the important point is that in spite of a great elaboration of detail there have been few really fundamental principles laid down since Kekulé. The famous father of the benzene ring would turn over in his grave, according to Dr. Derick, if he could witness the pot-boiling mess of cook-book chemistry that has been stewed up in some of our so-called industrial research laboratories. The question may well be asked: What is it that is sucking the life blood of science from the modern dye industry?

To some extent the answer is found in the views that some financial interests are constantly repeating: "Why make more dyes? We've got enough now. It would be better to standardize and cut costs on the ones we have, than to spend money on research for the next generation to capitalize on. Besides, it's usually cheaper to buy research than to manufacture it."

Fortunately there is an inborn curiosity in the real scientist that is not always going to be satisfied with *status quo*. Some time we are going to get down to fundamentals and when we do we are going to find that we need: (1) Accurate, reliable, physical constants for all dyes and intermediates. (We cannot write scientific and intelligent specification for one in a hundred of our products.) (2) Phase rule diagrams and supporting data for materials employed by the dye maker and the dye user. (Physical chemistry must form a more important part of the mental equipment of the future organic chemist.) (3) Analytical methods covering all phases of the dye industry. (The important, but not yet appreciated, work of Mulliken and others must be extended to build up a literature and practice comparable with that in inorganic technology.)

Why and how does a dye attach itself to fiber? This basic question is fundamental to the entire industry. As Dr. Derick argues, it may well be that we shall eventually need only the fiber itself to produce the color we desire. Surely there is much that lies ahead. As the last ten years was marked by the tremendous commercial development of the synthetic organic chemical industry in this country, it is to be hoped that the next will see the development of a scientific basis for an even greater industry in the future.

Patent Licenses Offered as Bait for Equipment Sales

AT THE RECENT convention of electroplaters considerable discussion about the lobbies arose as a result of a new type of sales argument which has recently been reported. This selling policy originated with a foreign manufacturer of electroplating equipment who has a controlling interest in certain patents applicable to electro-deposition of metals. This concern has been undertaking to use patent licenses as a bait to get purchasers for its equipment, making such licenses conditional upon installation of its machinery and apparatus.

There are legitimate ways in which patent rights may be used in promoting the business of equipment manufacturers. Such, for example, are the many cases in which the apparatus itself or its essential parts are patented. Naturally, under these circumstances, the patent license is almost inseparable from the equipment.

In the electroplating case above cited, however, the apparatus offered differs in no essential way from that manufactured and sold by several reputable American concerns. There is nothing in the patent which is being used as bait which relates to equipment superior to that of American manufacturers. In fact, many of those persons who might use the process alleged to be covered by the patent already have in their electroplating plants ample equipment and facilities, so that they could have no interest in a patent tied up with additional machinery purchases. Competent patent advice should be sought before entering into such an arrangement.

An Approaching Crisis in the Chilean Nitrate Industry

NITROGEN is the hub of the wheel on which are turning the most important of the international developments in the fertilizer industry. That Chile's natural monopoly of 95 per cent of the world's nitrate deposits is practically ended was forcefully emphasized by Dr. Harry A. Curtis of Yale University, at the Williamstown round-table conference on nitrogen. The growth of nitrogen fixation and the steady increase in the production of byproduct ammonium sulphate marks the beginning of the breakdown of the Chilean nitrate production and marketing system. "The monopoly is now ended," Dr. Curtis declared, "and with it must end the system built upon it. Chilean nitrate will by no means disappear from the market, not for another generation at least, but the present wasteful methods of extraction, the absurdly incompetent technology, the present burden of taxation and the excessive profits must all go as the new air-nitrogen industry of the world forces on Chilean nitrate a competition that it has never had to meet. The Chilean nitrate producers have this year made a 5 per cent reduction in the prices for nitrate during the coming year. This is a step along the way that nitrate must travel, but this small reduction will by no means meet the situation that will face the Chilean nitrate industry during the next five years. The beauty of the whole situation is that a consistently low price of ammonium sulphate will eventually drag down the price of Chilean nitrate."

Don B. Cohen, Secretary of the Chilean Legation at Washington, speaking before the same meeting admitted that his Government was gravely concerned with the unfavorable turn of the nitrate situation. In 1913 about 55 per cent of the nitrogen consumed by the world was from Chilean nitrate. Today it is nearer 30 per cent. Ammonium sulphate, cyanamid and other synthetic nitrogenous materials have increased from 45 to 70 per cent of the total. The industry at the present moment is in the most critical position in its history, but Señor Cohen expressed the belief that eventually it will be able to adjust itself to competition with the newer products and will continue for many years as an important factor in the world trade.

These references to the critical state of affairs in Chile are more than confirmed, however, by reports that reach us from other sources. The shutting down of nearly all of the nitrate oficinas has brought on a serious unemployment problem. The reduction in national income from the nitrate export tax and the general economic depression caused by the low prices fixed by the Nitrate Producers Association have given rise to a violent propaganda in favor of dissolving that body. The Association has plead for a reduction in the export tax. The Government is adamant, however, for it knows that present high costs are due in general to poor yields and slovenly processing methods.

Instead of recognizing the strong indications that low production costs will depend on more scientific methods and the abandonment of the intellectual dishonesty that has characterized technical accounting methods to date, the Association has chosen to sponsor an eruption of pseudo science. The "Comisión de Investigaciones Científicas" or Bureau of Scientific Research was formed last year and an army of "scientists" was engaged. With a pretended contempt for American technical methods, the personnel was made up entirely of Germans and Englishmen. The English and German directors of the new bureau soon found, however, that internal co-operation was impossible. As a result of mutual antagonism, two separate centers of investigation were established with separate laboratories, separate libraries and other facilities. The German director, with an imposing staff of German assistants, heads the station at Viña del Mar, a delightful suburb of Valparaiso, far removed from the nitrate pampa. Consequently, the men have no idea of technical and economic conditions as they really are.

The other center is near Antofagasta, on the pampa, under control of an English professor and an English staff. Between the two groups harmony reigns apparently on but one point—that work done by American technologists must be ignored. There has been no co-ordination or co-operation and the results obtained to date lead to the impression that the Bureau has been a complete failure. With the dissolution of the Association, if it comes about, there will likewise be an end to a venture that, from the start, was doomed to

failure because of unscientific partiality in its personnel, its organization and program of investigation.

In the meantime, it is not unlikely that the American technology so contemptuously shunned by the Association, will have forced its recognition upon the industry. The scientific process developed by the du Ponts and the probability that its basic ideas will be used to advantage by the Guggenheims at Coya Norte in an immense plant now under construction, suggests a marked decrease in manufacturing costs in the near future. By reason of large economies in material handling and by obtaining good extractions by leaching, the Guggenheim plant will doubtless produce nitrate cheaply and in quantity. Unless free sales are established before production starts (probably in October) it seems that a rupture must occur within the association of which the Guggenheims are nominal members.

The incidence of these commercial and scientific developments on the critical situation in the nitrate industry will be watched with close interest by the American consumer. It is certain that bad practice in such a large and grossly inefficient business cannot be corrected over night—nor even greatly improved on a national basis. But competent technology can point the way out of the industry's difficulties and help prepare it for the new competition with air nitrogen.

Water-Gas Manufacturers Should Make Plans Now

CONSTANTLY increasing demand for gasoline has been met to some extent by increased use of crude oil; but almost equally important has been the larger yield of gasoline per barrel of crude petroleum run to stills. This means more cracking of the light fuel and gas oils. Government data for the past ten years illustrate strikingly the trend. The quantity of gasoline made has increased from 2.06 to 10.89 billion gallons in the ten years, 1916 to 1925; but the percentage yield from crude has changed just as impressively, increasing every year, from 19.8 per cent in 1916 to 27.7 per cent in 1921 and further to 35 per cent in 1925. Well may at least 50 per cent be forecast for 1930—and that means no simultaneous yield of gas oil.

The petroleum refiner who wishes to make "cracked" gasoline now finds gas oil one of his best raw materials, worth at least 50 or 60 per cent as much per gallon as the market price of the gasoline. Heavier fuel oils are worth less, ranging from 30 to 50 per cent of the gasoline value per gallon, according to their analysis. The question now is, How much longer is the refiner going to sell gas oil to the manufacturer of water gas; or, when is he going to crack it all instead of selling a part of it?

This is a serious question for the city-gas manufacturer, and one he may as well face now. The water-gas maker cannot afford to pay 10 and 12 cents a gallon for gas oil; and yet that is an early prospect. The only satisfactory alternative is bituminous coal as a raw material for gas making. But coal-gas plants cannot be built in a day, nor in a six-month period either.

It is now none too soon to decide how much new coal-gas capacity is going to be needed in 1928 and 1929. Financial and engineering preparation can then be made in an orderly way. Much of the shock to the industry which will accompany wide-spread forced change to coal gas can thus be absorbed on the economic springs of business preparedness.

Co-operation as an Aid to Conservation

CAREFUL study of the report of President Coolidge's Oil Conservation Commission shows it to be quite a different document than the newspaper headlines would lead one to believe. The skillfully worded threat of a shortage within six years turns out to be a sort of window-dressing that doubtless served its purpose when it brought wide publicity to the Board's activities. In the main, the report is most sympathetic, and should prove helpful to those in the industry who will heed its recommendations.

Theoretically, if the present pumping and flowing wells in the proven sands continue to produce at their present rate, the total output would be only about 4,500,000,000 barrels. No consideration is taken, however, of improved methods of recovery, of deeper drilling, nor of the results of new exploration which to date has kept production in considerable excess of a rapidly increasing demand. Many promising foreign fields are yet untapped. The Board, of course, appreciates the fact that these reserves of the future are a much greater protection than those of the immediate present. In fact one of the very apparent purposes behind this report is the desire to stimulate the industry toward a realization of these same objectives. The recommendation that private enterprise must carry the burden of this development should also be encouraging to an industry that has sometimes faced the threat of government ownership and control.

Co-operation is the solution of the conservation problem and the Board would have the federal and state governments recognize this by providing legislation that will remove any doubts as to the illegality of concerted action. Increased recovery through the common control of producing properties in a single pool may soon be possible. Co-operation in the field of research is already possible, and the Board urges "systematic research and experiment upon methods of securing a larger proportion of oil from the sands, * * * and in new methods and cheapened costs in refining and cracking oils and in waste elimination." There can be no exception to the view that "larger savings in both production and refining are possible through the general adoption of the best technique already used by the more progressive units." And the conservation that will result from the better utilization of petroleum products through the design of more economical motors and the diversion of crude oil from less essential to more essential uses should find no permanent opposition from the petroleum industry.

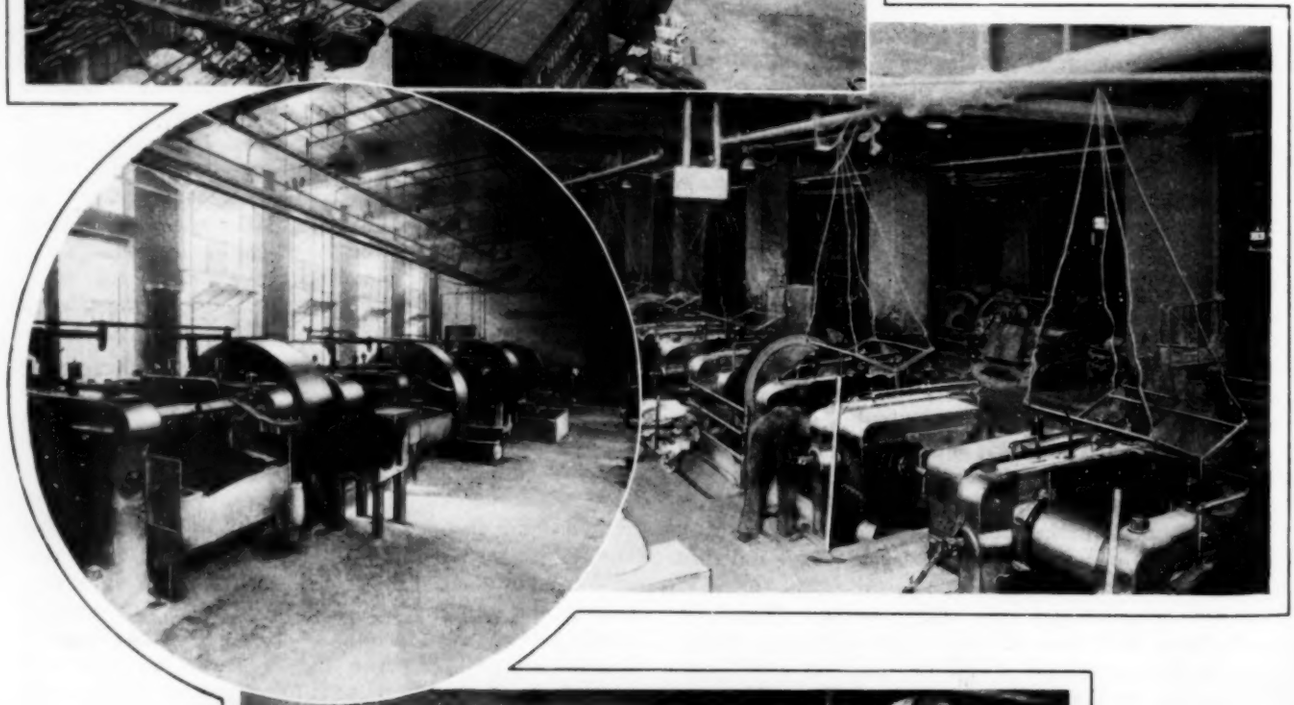
Secretary Hoover's determined opposition to the foreign monopolies that control our supplies of certain essential raw materials is to be seen in more than one place in the Board's report. "Our experience with the exploitation of our consumers by foreign controlled sources of rubber, nitrate, potash and other raw materials should be sufficient warning as to what we may expect if we shall become dependent upon foreign nations for our oil supplies."

The present report is a preliminary one and will be followed by others on foreign oil resources and on the development of possible substitutes from coal and shale. The program thus laid out promises intelligent, sympathetic dealings with an essential industry. It sets a precedent for petroleum that may help to conserve other of our basic natural resources.

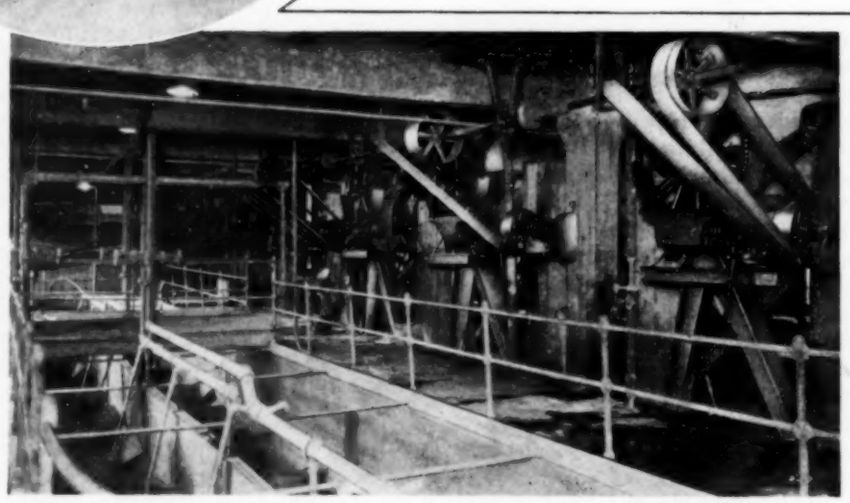
Modern Equipment for Reclaiming Tire Stock

LEFT.—*Reclaiming tires is a business of small margins. Note cranes for handling raw stock.*

BELOW. — *The digested and dried stock is plasticized in heated rolls, after which it is refined to remove particles of foreign matter.*



ABOVE.— *Battery of refining mills for removing non-plastic material from stock.*



LEFT.— *Battery of rotary devulcanizers, each with a capacity of about 2 tons per charge.*

Reclaiming Rubber from Tire Stock

Description of alkali process which has become big factor in lessening raw rubber consumption

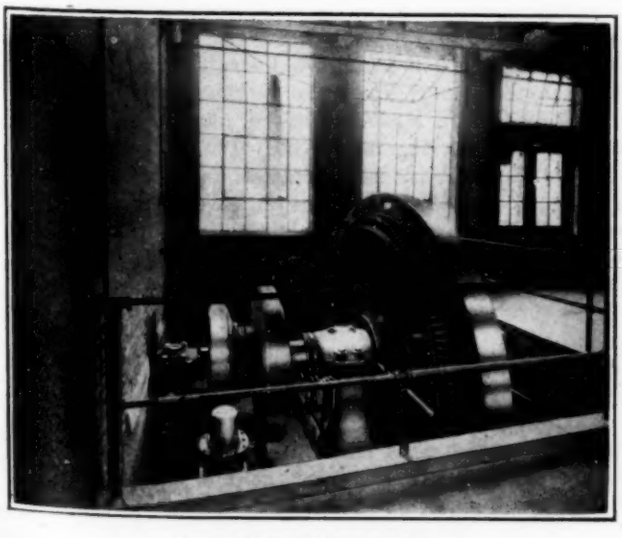
HIGH-GRADE tire stock for reclaiming rubber consists of three kinds: (1) Pneumatic-tire casings from which the bead has been removed, (2) solid-tire treads and (3) inner-tube stock.

The bead and adjacent stock is removed before shipment to the reclaim plant, as this reduces the weight about 25 per cent. When the stock is received at the plant, it is stored either in the open air or under sheds, as a moderate amount of weathering has no harmful effect.

The first manufacturing operation on the stock is cracking. This is done in a double-corrugated mill, the rolls of which rotate differentially in the ratio of about 1½ to 1. The rolls are 36 in. long and 19 in. in diameter. These dimensions have been found to be most economical of power for a given production. Rolls of much greater length would bend, allowing an inordinate increase in clearance. Ordinarily, the stock is passed through two mills arranged in series, a conveyor being placed between them. As the stock falls from the rolls, it drops to a shaking screen which removes all shreds less than 1 in. in longest dimension. The oversize pieces pass through the mills again, making a closed-circuit system of subdivision.

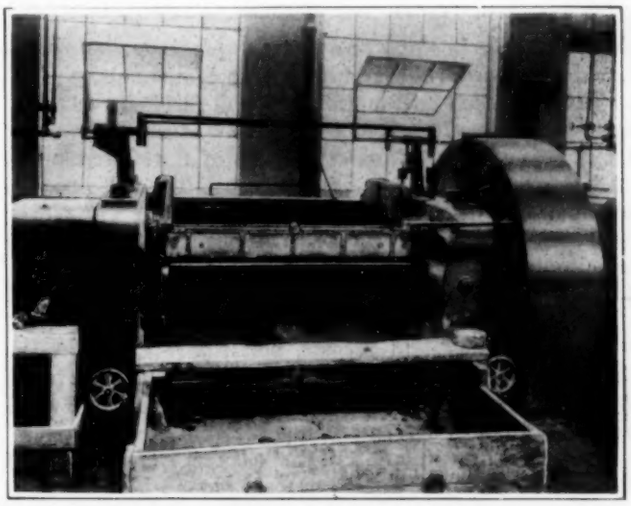
Devulcanization Restores Plasticity

After reduction to 1 in. or less, the stock is conveyed to the devulcanizers, which are steam-jacketed cylinders holding about 3,000 to 5,000 lb. of stock each. The weight of caustic soda used is about 13 per cent, based on the dry stock and this is added as a 20 per cent solution. Steam pressure in the jacket varies from 125 to 200 lb. per sq.in. and the time of cooking varies from 16 to 24 hr. depending upon the character of the stock. In average practice, a steam pressure of 125 lb. per sq.in. is maintained from 18 to 22 hr. Throughout the period of cooking, the batch is agitated gently by the slow rotation of the devulcanizers.



An Efficient Electric Drive

This 300-hp. synchronous motor drives 4 refining mills and two warming-up mills. The motor is reversible and drives through a brake clutch.



Warming-Up Mill of Modern Design

In order to increase the plasticity of the devulcanized and dried stock, it is milled in steam-heated rolls about 60 in. long.

From the devulcanizers, the digested stock is discharged to a washing machine, either of the open-cradle, or of the beater type. After washing, the wet stock passes through a squeezing machine, thus removing a large part of the water mechanically. The wash water is discharged through a save-all or sewer-screen, which recovers a surprising proportion of valuable stock. Wire cloth of about 100-mesh is used in the screens. It has also been found worth while to recover at times part of the rubber stock that passes through the save-all as a finely-divided suspension.

Dried Stock Has Low Tensile Strength

The stock from the squeezing machine and save-all is combined and elevated to the dryers, which remove all but the equilibrium moisture at ordinary atmospheric conditions. Two kinds of drying equipment, vacuum and hot air, are suitable and the over-all costs are about equal for both methods. Large cylindrical dryers of the vacuum-tray type will do the work quick and with good heat economy, but against these advantages must be balanced comparatively high investment and labor charges. Air dryers are of the pitch-roof type, over which the material falls. Moisture is removed by hot air passing upward through the roof, which consists of finely perforated sheet iron. With this dryer, which can be built by ordinary plant mechanics, the investment and labor costs are low, but the heat economy is relatively poor. Furthermore, the floor space required is comparatively great.

Drying is the last step in the making of raw shoddy. At this stage, the material has lost most of its tensile strength, and is distinctly plastic in character. In addition to devulcanization, the caustic cooking dissolves most of the cotton fabric, leaving only the finely divided impurities, the removal of which is the object of subsequent operations.

After drying, the raw shoddy goes to a warming-up mill, which has 60-in. steam heated rolls. Here the

stock is softened sufficiently to pass through a series of 3 or 4 refining mills, each of which removes impurities such as undissolved fabric, dirty stock, bits of wood and filler. The refining mills have 19 x 36 in. rolls that operate hot. The thickness of stock coming from the last refiner is 0.0025 in. and any impurities of consequence can be detected easily in this sheet which emerges the full width of the roll. As a result of refining, from 10 to 15 per cent of tailings are removed from the entering raw shoddy, the remainder being finished reclaimed rubber suitable for compounding.

With trimmed pneumatic tires, the yield of reclaimed rubber is about 70 per cent of the raw stock on a weight basis. A refining plant consisting of 8 refining mills, each 19 x 39 in. and 4 warming-up mills, will produce about 25,000 lb. of reclaimed rubber a day. The power consumption for refining alone is about 600 hp., which is supplied by two 300 hp. reversible synchronous motors equipped with direct drive through a brake clutch.

A factor in the location of reclaiming plants is that of water supply and stream pollution. Cheap water should be available if the washing operation is to be economical, and the discharge of the dirty alkaline wash waters into open streams is not feasible.

At one reclaiming plant that has a large site in a country town, an ingenious process has been devised for preventing stream pollution. The wash water discharges to one of two settling ponds that are operated alternately. When one pond becomes full, the supernatant liquor is drawn off and charged to a large sand pit which acts as a filter. The sludge is removed from the pond and dumped. Weathering gradually reduces the moisture contents of the sludge. As the finely-divided floating stock is held in suspension, it is possible to recover considerable rubber from the supernatant liquor by passing it through a basket-type centrifuge. This is done when the price of crude rubber is sufficiently high to warrant such recovery.

Notable Advances in Rubber Chemistry Reported

Vulcanization of latex, dissection of latex globule and radiography of rubber described at A. C. S. symposium

Members of the Division of Rubber Chemistry, American Chemical Society who attended the Philadelphia meeting, Sept. 6 to 10, were privileged to hear Dr. P. Schidrowitz, consulting chemist of London, speak on "The Direct Use of Rubber Latex, with Special Reference to Vulcanized Latex." Doctor Schidrowitz succeeded in vulcanizing latex with ordinary flowers of sulphur, without heat and pressure, a reaction that would not ordinarily be expected. Many industrial uses of vulcanized latex are at once suggested, especially the manufacture of dipped goods and rubberized fabrics.

Interesting researches on the structure of rubber were described by Dr. G. L. Clark, director of the x-ray laboratory of applied chemistry, Massachusetts Institute of Technology. Doctor Clark reviewed the utility of x-rays in experimental chemistry, with special reference to crystals structure and the identification of colloids. Radiographs of rubber, balata, gelatine and several crystalline substances were shown, each with patterns characteristic of its structure. While the structural formula for rubber has not been fixed, Doctor Clark hopes to answer this old question before long. Crystalline rubber, which Pummerer claimed to have made, has not been duplicated in any laboratory, and Pummerer himself failed to note the exact conditions which cause crystal formation.

In the absence of Dr. E. A. Hauser, his paper on "The Dissection of the Latex Globule Recorded by Micro-Motion Pictures," was presented by Dr. G. L. Clark. The film showed a latex globule to comprise an outer skin containing a viscous liquid. The globules were punctured with glass rod drawn to an extremely fine point, the experimental technique developed being as impressive as the actual results.

The outlook for alternative materials for rubber does not appear to be promising in light of Dr. E. B. Spear's paper. So many desirable physical properties can be combined in vulcanized rubber that satisfactory substitutes for any one of the important compounded stocks seem improbable of discovery. Elasticity is the property that substitutes must have, along with others, of course.

Rubber Planters Now Rely on Botanical Science

Problems of the rubber planter were outlined by J. W. Bicknell, vice-president, treasurer and secretary, U. S. Rubber Plantations, Inc., which is the largest and oldest of American rubber-growing companies. The greater proportion of present plantings was started by practical growers, most of whom migrated from sugar and tea plantations. Not until root disease, falling leaves and white ants beset rubber trees, did the scientist obtain a foothold, and as a consequence, there exists extreme variations in methods of tree propagation, irrigation, tapping and fertilization. Budding, a comparatively new method of selection, is being investigated by botanists, as are comparative methods of tapping. The quantity of latex yielded varies but little with the method of tapping, the reaction of the raw rubber to vulcanization is, however, affected appreciably by rest periods, thus showing that the latex composition depends somewhat upon whether the tree is tapped continuously or is at rest. The average yield per acre per year is about 600 lb., which is likely to be considerably increased as new knowledge is applied.

Danger of Rubber Shortage Seen

Assuming rubber demand to increase 5 per cent during each of the next 5 years, a shortage may be reached during 1929, said H. N. Whitford, of the Rubber Association of America, Inc. Since 1901, the proportion of plantation rubber has increased from nothing to 93 per cent of the American consumption. A price of 42c. per lb. in New York is equivalent to 25,000 tons of wild rubber, including both the South American and African supply, and a price of 56c. would be necessary to bring 70,000 tons of wild rubber to our ports annually. Although the potential supply of wild rubbers, especially from the Amazon, is probably much greater than 70,000 tons, the cost of harvesting, and lack of operating capital makes a greater quantity unlikely. Doctor Whitford scouted the idea that there might be 300,000,000 rubber trees in South America, as has been estimated. Assuming normal yields, the present output could come from 21,000,000 trees, he said.

Editor's Note.—Other abstracts of Rubber Division papers appear on p. 536.

Solving Some Unusual Problems in Sand Filtration

Clarifying softened boiler-feed water involved unexpected difficulties due to entrained air that caused precipitate to penetrate into sand surface

By Marion E. Dice

Testing Engineer, General Petroleum Corporation of California, Los Angeles, Calif.

RECENT studies on the subject of gravity filtration of softened water through sand have disclosed the fact that entrained air injected during the softening process destroys the filtering properties of the surface of the sand. When air is present in excess of its solubility, the bubbles pentrate into the sand and make a porous structure like that shown in Fig. 1. This allows the precipitate to work its way into the sand instead of being stopped at the surface.

Such action presents no great difficulty with sand filters which are revivified by back-washing. Within the past two years, however, apparatus has been placed on the market which renews the filtering surface by scraping off the settled solids together with a thin film of sand (or other filtering material) and discharging them through a sediment outlet. (See Cunningham, "An improved thickener-filter for chemical operations," *Chem. & Met.*, pp. 750-2, Sept., 1925.) In apparatus of this nature, such a structure as that shown in Fig. 1 would require the removal of too thick a layer to be economical. This discussion will be of interest, therefore, to operators who are using or considering gravity filters with mechanical cleaning devices in which liquids are to be filtered following any process in which air agitation is used.

Many industrial plants still use lime-soda water softening processes where power plants run non-condensing and where processes do not demand zero-hardness. In the older plants where softening is not a continuous process it is common practice to place the proper charge of hydrated lime and sodium carbonate in a tank of raw water and to agitate with air until the reaction is complete. The water is then decanted directly or after settling for a time, filtered, and used. A gravity filter was proposed to handle 1,000,000 gal. of water per day from a process such as this, and the following investigation was made to obtain design data for it.

Difficulties Due to Entrained Air

A series of experiments was first made with the apparatus shown in Fig. 2 to determine the rate of flow of clear water through sand under various conditions. Treated water from a cold lime-soda process in which air agitation was used was then tried. The rates with softened water showed no agreement among themselves and in general were higher than those obtained with clear water. Due to the precipitates in the softened water the rates should have been lower. Very little sediment collected on the sand surface, but it could be seen through the glass wall of the filter mixed with the sand for a depth of one to two inches below the surface. The penetration occurred not only at the edges but over the entire area. The photograph (Fig. 1) was taken of a vertical section near the center of the filter. When the filter was jarred or the sand surface was stirred with a rod, large bubbles of air rose from the sand.

The water was found to contain 7 cc. of air per liter in excess of saturation at 68 deg. F. The bubbles were so small that the suspension was very stable; vessels of water could stand for hours without a decrease in the air content. At the same time the bubbles were too large to pass through the pores of the sand.

Passing the water through a vacuum chamber to remove the air was tried with fair success. It is obvious that with sufficient vacuum any portion or all of the air may be removed. A vacuum of 29.2 in. of mercury at sea level will reduce the boiling point of water from 212 deg. F. to 68 deg. F. Since the solubility of a gas in a liquid is zero at the boiling point of the liquid, this vacuum would remove all the air, both entrained and dissolved. Some lower degree of vacuum would remove enough air to prevent damage to the sand surface, but would be uneconomical because of the energy cost.

A simpler method of eliminating the trouble was found in the use of sufficient pressure to place the entrained air in solution, in which state it passed freely through the sand. The weight of a non-reacting gas that will dissolve in a liquid is proportional to the pressure of the gas according to Henry's law. Therefore

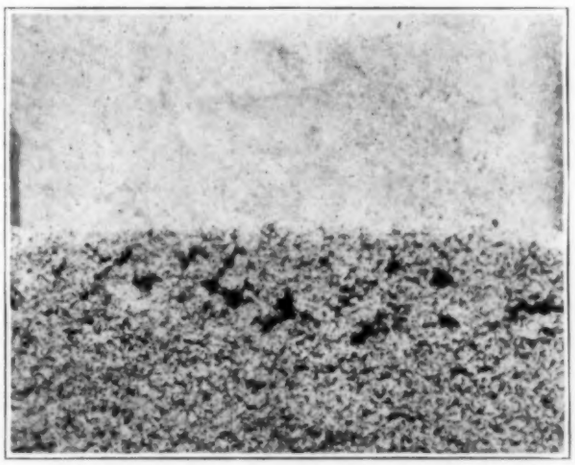


Fig. 1—Cross-section of Sand Filter Bed Honeycombed by Air
It will be noted that the precipitate has penetrated about one inch into the sand instead of forming an effective filtering film on the surface

by making the filter tank high enough, the hydrostatic head at the sand surface may be increased, and with it the solubility of air in water, until all the air is in solution. The air will then pass through the sand and be released at some point of low pressure. In this case the air is released in the feed-water heaters and the water passes to the boilers at a temperature of 212 deg. F. free of air. At 68 deg. F., 1 liter of water dissolves 18.7 cc. (Winkler, "Technical Chemists' Handbook," Lunge.) of air (measured at 32 deg. F., 14.7 lb. per sq.in.) This volume of air measured at 68 deg. F. is 20.0 cc., which represents the dissolved air present. The amount of entrained air was found to be 7 cc. per liter, making a total of 27 cc. per liter. To find the pressure required to dissolve the entire amount at 68 deg., it is necessary only to find at what pressure a quantity of air occupies a volume of 20 cc., if it occupies 27 cc. at 14.7 lb. per sq.in. The absolute pressure, calculated from Boyle's Law, is 19.86 lb. per sq.in. This indicates that the pressure at the sand surface should be increased by the difference between 14.7 lb. and 19.86 lb., or 5.16 lb. per sq.in., or 11.9 ft. of water.

Determining Necessary Hydrostatic Head

To obtain such a head, the apparatus shown in Figs. 3 and 4 was constructed. The filtering medium was 36 in. of Seal Beach sand above a bed of crushed stone and boulders. In order to maintain a constant head which could be adjusted to any desired height, a swing-pipe overflow was used. Sufficient water was admitted to the filter at all times so that there was a slight overflow. A vent pipe was placed at the highest point of the swing-pipe to prevent any siphoning action. The swing-pipe was supported by a rope which passed over a pulley and down to the ground, so that the elevation of the high point could be adjusted at will. A steel tape, weighted at the lower end, was suspended from the upper cross-pipe as shown in Fig. 4. A piano wire was stretched horizontally at the elevation of the sand surface. The elevation of the top of the swing-pipe above the sand surface was then read from the tape at its intersection with the wire. This method of measurment was abandoned for a mercury manometer when it was found that pipe friction was not negligible.

The results agreed with calculations, as there was no

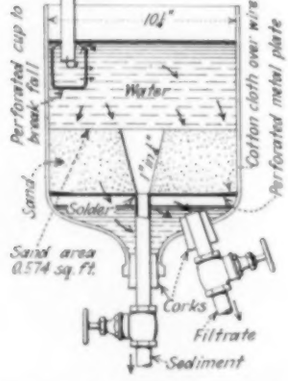


Fig. 2—Apparatus for Studying Flow Through Sand Under Various Conditions

This experimental apparatus made by cutting the bottom out of a 5-gal. glass bottle afforded an easy means of studying penetration of the precipitate into the filter sand

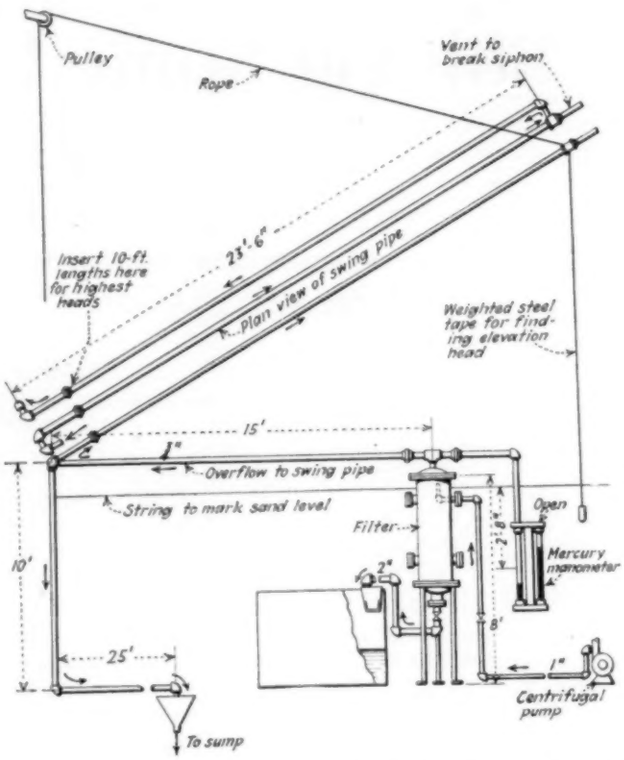


Fig. 3—Equipment Used for Studying Effect of Hydrostatic Head

By raising or lowering the swing pipe shown above the filter it was possible to vary the head over a wide range and thus materially affect the solution of entrained air

penetration by air under heads of more than 12.3 ft. of water. The critical point was not determined exactly; it was between 9.5 ft. and 12.3 ft. The calculations had indicated 11.9 ft.

Fig. 5 shows a cross-section of the sand and precipitate after 48 hours of flowing under a head of 39.5 ft. The precipitate was tightly compacted and pasty and could be rolled up from the sand surface without retaining much sand.

Such high heads are not advisable where the removal of bacteria is desired. (Turneaure and Russell, "Public Water Supplies," New York, 1901). The increased velocity of the water through the voids probably reduces the bacterial efficiency, with which in this case we are not concerned. Hatschek ("The Mechanism of Filtration," J. Soc. Chem. Ind., London, 27, 538, 1908), experimenting with the effect of pressure on filtration, found that the pressure with which particles of sediment are held together after the surface cake has begun to form may be increased by increasing the pressure, but the structure of the deposit and the percentage of voids cannot be altered thereby. This applied to rigid precipitates, to which class the carbonates and sulphates of softened water belong. It would not be true with plastic material. It is reasonable to expect therefore that no harm will accompany the use of high heads.

Fig. 6 shows the results of 24-hour tests under various heads. The rates for low heads increased at first, due to penetration, then decreased as the precipitate worked into the pores. The rates for higher heads decreased rapidly at first as the precipitate filled the surface voids and formed a compact structure, then more slowly as the cake built up.

Fig. 7 shows the initial rates of flow under various water heads. The relationship shown by this curve

should not be used for any set of conditions other than those prevailing at the time of these tests, because several factors other than the head of water affect the rate. These tests were all made with a sand bed composed of 3 ft. of Seal Beach sand, effective diameter 0.206 mm., and at a temperature of 68 deg. F. The curve indicates that the initial rate of flow (or in the case of clear water the rate at any time) is directly proportional to the first power of the pressure. This

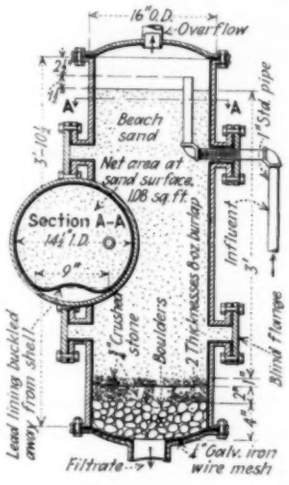


Fig. 4—Details of Experimental Filter Bed in Equipment Shown in Fig. 3

Salvaged apparatus was used in these tests so that the lead lining and the extra connections shown have no significance

is in accordance with the laws of capillary flow determined by Poiseuille ("Memoirs des Savants Etrangers," 11, 433, 1846) and applied to the flow of water through sand by Darcy). ("Les Fontaines Publiques de la Ville de Dijon," Paris, 1856.)

Formulas for Rates of Flow

An empirical formula published by Allen Hazen ("Filtration of Public Water Supplies," New York, 1895) was checked experimentally and was found to agree quite well with laboratory data. The formula contains a coefficient which may vary over a wide range depending on such factors as the porosity, degree of packing and shape of the sand grains, so it was necessary to determine the coefficient experimentally. This was done, with good results. The formula was intended for clear water; it therefore gives only the initial rate for turbid waters which soon clog the filtering pores with sediment. In the original form, the rate was given as a velocity in meters per day. For convenience it has been changed below to a quantity in gallons per minute per square foot of cross-sectional filter area. A conversion factor is therefore introduced in addition to Hazen's coefficient, which retains his values.

$$Q_o = .01704\, C\, d^2\, \frac{h}{l}\left(\frac{t+10}{60}\right)$$

Q_o = initial rate of flow, gallons per minute per square foot of cross-sectional area.

C = Hazen's coefficient of packing, ranging from 400 to 1,200 for new sand. The coefficient is higher for loose sands and lower for compact sands. It decreases with time. For average values, use
700 to 1,000 for new sand
500 to 700 for sand which has been in use a number of years.
(By experiment, the value for new Southern California beach sand was found to be 1,064.)

d = effective diameter of sand particles in millimeters. The effective diameter is such that 10 per cent of the particles (by weight) are smaller and 90 per cent are larger than itself. It is determined by sieve analysis.

h = depth of water above the sand surface, in any linear unit provided the same unit is chosen for l.

l = thickness of sand traversed, in the same unit as h.

t = temperature in degrees F.

Hazen's formula gives close results with temperatures from 40 deg. to 80 deg. F. Below 40 deg. and above 80 deg. the calculated rates are lower than the actual. Fig. 8 shows the temperature factors calculated from Hazen's expression $\left(\frac{t+10}{60}\right)$ compared with those calculated from the viscosity of water at various temperatures. Bingham & Jackson, "Viscosity Standards," U. S. Bureau of Standards scientific paper 298, 1917.) The factors given by the upper curve of Fig. 8 are nearly identical with factors proposed from experimental work by Poiseuille ("Memoirs des Savants Etrangers," 11, 433, 1846), by Carpenter ("Seepage of Return Waters from Irrigation," Colo. Agri. Col. Exp. Sta. Bull. 33, 1898), and by Slichter ("Field Measurements of the Rate of Movement of Underground Waters," water supply paper No. 140, U. S. Geol. Surv., 1905), whose work extends over half a century. For higher temperatures, the upper curve should be used. In the case of filtration following a hot softening process a large error would be introduced by using Hazen's coefficient.

While the above formula is useful for finding the initial flowing rate, it does not take into consideration the retarding effect of sediment deposited on the filter by turbid waters. If the slurry is of uniform composition throughout the flowing period, the ratio of the rate at any time to the initial rate should be a function of the time elapsed since the start with a clean filter. In order to determine the function mathematically, several of the curves of Fig. 6 were plotted on logarithmic co-ordinates (Fig. 9) and were found to be straight lines. Their equations are therefore of the form

$$y = c\, x^n$$

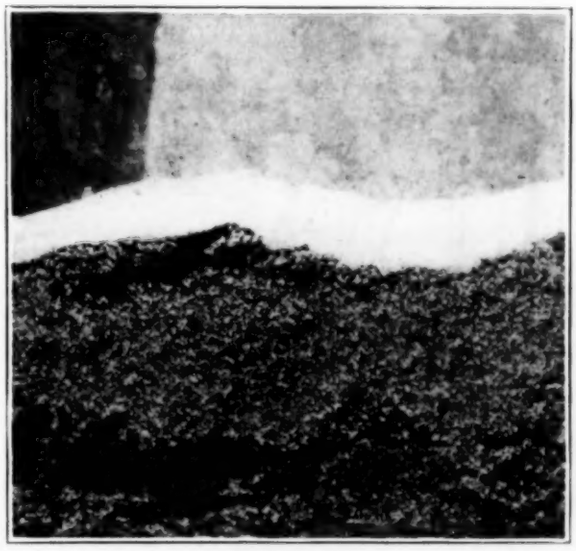


Fig. 5—Cross-section of Sand Filter Bed Undamaged by Air After 48 hr. of Operation Under a Head of 39.5 Ft. of Water

The precipitate in this case is tightly compacted and can easily be separated from the sand surface

in which n denotes the slope of the line and c is the value of y when $x = l$. The ordinates represent the ratio of the rate after T hours (Q_T) to the original rate (Q_o), so

$$y = \frac{Q_T}{Q_o}$$

The abscissas represent the elapsed time T in hours, so

$$x = T.$$

Substituting in the above general equation,

$$\frac{Q_o}{Q_T} = c\,T^n.$$

The slope of the curves is negative, because as the time increases, the ratio of the rates decreases.

$$n = -0.448.$$

An exact value for c is not indicated by these curves, because they are not entirely consistent. The curve for a head of 39.5 ft., falls above that for 32.7 ft., which was not expected. The higher the head, the greater the rate and hence the greater the sediment deposit, which would tend to place the curves for higher heads below those for lower even on a ratio basis. From the curve for 32.7 ft.,

$$c = 0.26.$$

The equation then becomes

$$\frac{Q_T}{Q_o} = 0.26\,T^{-0.448} \text{ or } Q_T = \frac{0.26\,Q_o}{T^{0.448}}$$

From this equation the rate (for this particular water) at any time after starting the filter may be calculated.

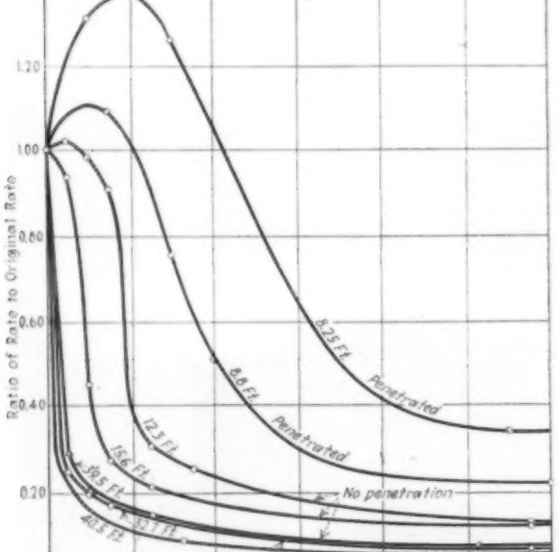


Fig. 6—Results of 24-hr. Tests Showing Effect of Various Heads

There was no penetration by air under heads of more than 12.3 ft. of water. The critical point is between 9.5 ft. and 12.3 ft.

This expression holds when the filtrate is removed as fast as it comes through the sand; in other words, when the filter is passing its maximum quantity at all times during the flowing period. In many cases it is desirable to use the filter tank itself as a storage reservoir and to remove the filtrate at a *constant rate*. In this case it would be necessary to clean the filter when its rate dropped to the demand; if it were not cleaned, it would no longer supply the demand. In such a case the filter does *not* pass its maximum quantity throughout the flowing period and the period is consequently lengthened. To determine the time at constant rate, calculate T by the above formula, using the initial rate Q_o from Hazen's formula and the demand rate Q_T of the particular conditions. By integration find the total quantity of water passed in T hours and divide this quantity by the rate per hour; the quotient is the time in which the same quantity will pass at the constant rate as would pass in T hours if removed as fast as it came

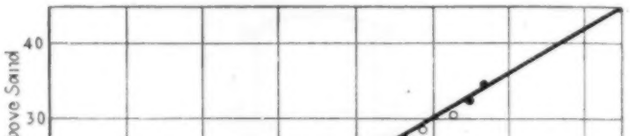


Fig. 7—Initial Rates of Flow Through Filter Under Various Heads

through the filter. A numerical example will make this more clear:

Assume that the initial rate Q_o is 7 gal. per min. per sq.ft. The filtrate demand is constant, 1 gal. per min. per sq.ft. It is desired to clean the filter as soon as the rate drops to 1 gal. per min. First calculate the flowing period T in which the rate gradually diminishes from 7 to 1 gal. per min.

$$Q_T = \frac{.26 \times 7}{T^{0.448}} = l$$

$$T = (.26 \times 7)\,\frac{l}{0.448} = (.26 \times 7)^{2.23} = 3.8 \text{ hours.}$$

Next, find the total quantity handled in 3.8 hr., under these conditions. Let W denote the total quantity. Then

$$dW = Q_T\,dT = \frac{0.26\,Q_o}{T^{0.448}}dT$$

$$W = 0.26\,Q_o \int_o^T \frac{dT}{T^{0.448}} = 0.26 Q_o\,\frac{T^{0.552}}{0.552}$$

In this particular formula Q_o must be expressed in gallons per *hour*, therefore

$$W = \frac{0.26 \times 7 \times 60 \times (3.8)^{0.552}}{0.552}$$

At a constant rate of 1 gal. per min., 413 minutes or 6.9 hours will be required. In other words, a filter with an initial rate of 7 gal. per min. per sq.ft. will pass 413 gal. per sq.ft. in 3.8 hours if the filtrate is removed as fast as it flows through the sand. This volume of water will deposit sufficient sediment to lower the rate to 1 gal. per min. per sq.ft. at the end of 3.8 hr. If, however, the filtrate is removed at a constant rate of 1 gal. per min. per sq.ft., 6.9 hr. will be required to pass 413 gal. and thus deposit enough sediment to lower the rate of filtration to 1 gal. per min. per sq.ft. If the filter surface is not cleaned at this time, the demand rate can no longer be furnished.

All of the above formulas for sediment-bearing water have been developed experimentally for one particular

water. They apply only roughly to other softened waters containing calcium carbonate and sulphate precipitates, and should be redetermined for other applications. Their discussion is of more interest for the method than for numerical results obtained.

Desirable Characteristics of Filter Sand

Nothing has been said thus far concerning the characteristics which make a sand desirable for filtering purposes. Hazen originated two empirical properties, both taken from a sieve analysis, which completely describe a sand. He specified the relative size of the particles by the *effective diameter*, which is the screen

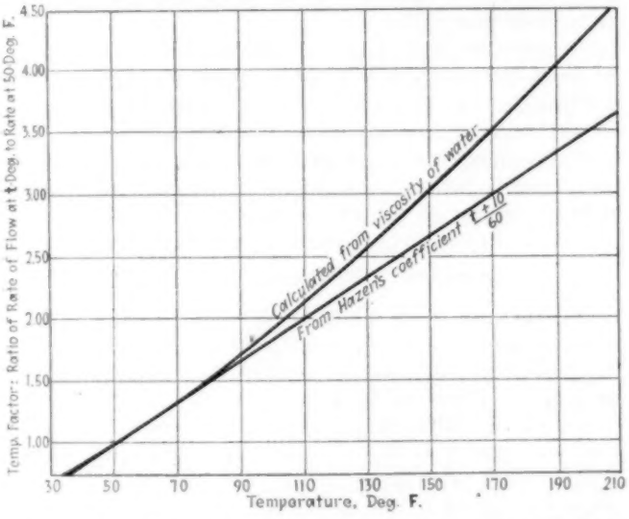


Fig. 8—Temperature Correction Factors to be Used in Applying Hazen Formula to Filtration at Higher Temperatures

opening which will retain 10 per cent by weight and allow 90 per cent to pass. His *uniformity coefficient* is the ratio of the opening which will pass 60 per cent to that which will pass 10 per cent. The coefficient is therefore equal to or greater than unity, a coefficient of unity indicating a sand the grains of which are of practically the same diameter throughout.

The results of sieve analyses should be plotted on semi-logarithmic paper, with the abscissas proportional to the logarithms of the grain diameters. Materials of equal uniformity then have curves of similar shape. The degree of fineness indicated by the effective diameter determines the position of the curve along the length of the diagram.

For filtering purposes, a sand should have a low coefficient of uniformity, because the more uniform the particles, the larger is the void space between them. In sands which have a high coefficient of uniformity, there is a grading of sizes from small to large and the small particles fill the voids between the larger ones and make a dense structure. Such a structure is admirable for concrete, but not for filtration. Sea sand is not used for concrete because its uniformity prevents a dense structure; this very fact makes it desirable for filtering. In the neighborhood of the seacoast it is a very cheap material, the cost being limited to transportation.

Fine sands are preferable to coarse, according to Turneaure and Russell ("Public Water Supplies," New York, 1901), because they permit steadier action and prevent disturbances due to scraping the surface. They also cause a greater loss of head in the filter and so make the action more uniform over the filter area. On

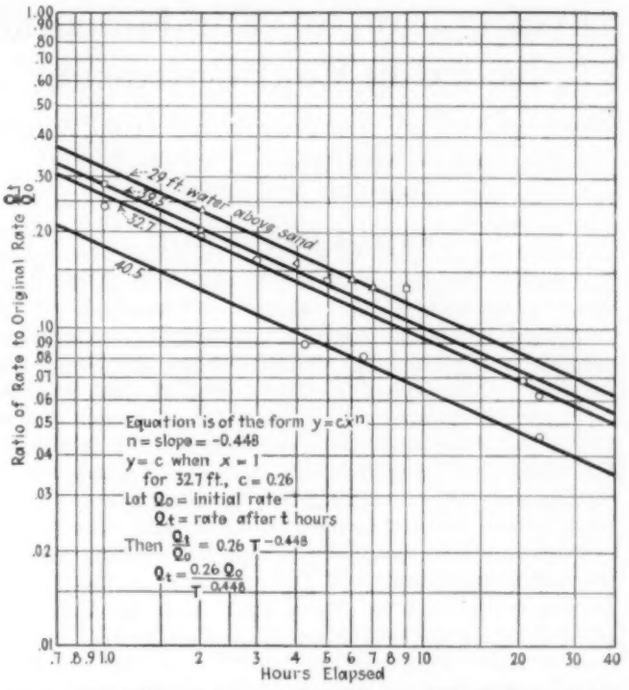


Fig. 9—Replotting Curves of Fig. 6 on Logarithmic Co-ordinates Shows Straight Line Function

the other hand, fine sand becomes clogged sooner than coarse, but with waters containing a very fine sediment, coarse filters may become clogged to a considerable depth, requiring removal of too thick a layer for cleaning.

Beach sands of Southern California were found to be finer and more uniform than those of the middle Atlantic states and European shores. The table shows their properties and those of some sands used in municipal filters in the East and abroad. (The latter data are quoted from Mason's "Water Supply," New York, 1916.)

Properties of Various Sands Used for Filtration

Sand	Effec. Diam. Mm.	Uniformity Coefficient
Seal Beach, Calif.	0.206	1.36
Redondo Beach, Calif.	0.246	1.24
Long Beach (wind drifted dune sand)	0.109	1.88
Sand for concrete (for comparison)	0.173	4.12
Washington, D. C. filter	0.32	1.64
Albany filter	0.31	2.3
Pittsburgh filter	0.29	2.1
Philadelphia filter	0.28	2.5
Hamburg filter	0.31	2.3
Altoona filter	0.37	2.0
Berlin filter	0.35	1.7
Zurich filter	0.30	3.1
Liverpool filter	0.32	2.5
The Hague (dune sand)	0.19	1.6
Mason's general specification	0.35	1.5

Acknowledgment is made to L. H. Biggar of the Hardinge Company, New York, for his hearty co-operation; to Nevin R. Shade of the General Petroleum Corporation for many suggestions during the progress of the work; and to Elmer J. Weitekamp and Hugh J. Byrne, who performed most of the laboratory work.

New Use for Helium

Helium seems likely to find a new and important use in the conduct of diving and tunneling activities as the result of tests made at the Bureau of Mines experiment station at Pittsburgh. When mixed with oxygen, helium forms an atmosphere that is as breathable as normal air, and the tests indicate that the use of helium-oxygen mixtures materially reduces the time of decompression —the process to which those who have worked in compressed air are subjected before they enter outside air.

Investigation of Fundamentals Needed in Coal Processing

Symposium on processing of coal under auspices of American Chemical Society stresses this need

Editorial Staff Report

UNDER the able guidance of chairman S. W. Parr, the Division of Gas and Fuel Chemistry of the American Chemical Society conducted a symposium session in Philadelphia on September 9, during the meeting of the society. Processing of coal was the topic and the papers read covered future trends in low-temperature carbonization, developments in several of the many low-temperature processes, and reports of studies on coke-oven gas, low-temperature gas, low-temperature tar and low-temperature light oil.

Professor Parr pointed out that the meeting marked the 100th anniversary of fuel research in the United States, for it was in April, 1826, that M. Bull read before the American Philosophical Society in Philadelphia a paper reporting the results of an investigation into the comparative heating value of American fuels, using shellbark hickory as a standard. In the succeeding 100 years research has gone little beyond this study of comparative value of fuels. Today, however, investigation into the fundamental facts underlying the processing of coal is under way in many places and Professor Parr regards the carrying to successful completion of such researches as one of the most important tasks facing the chemist.

Success Attending Efforts in Low-Temperature Field

Over 50 years ago, Siemens said that raw coal should not be used for the production of heat in any way at all. It is only recently, since a number of the various proposed low-temperature carbonizing processes promise commercial success, that the realization of this dictum seems probable. For, however useful by-product coking is in the preparation of industrial fuels, it is to these low-temperature processes that one must look for the production of a suitable domestic fuel from bituminous coal.

C. V. McIntire and L. R. Thomson gave a paper on "Low-Temperature Semi-Coke in Briquetted Form," describing the successful commercial operation of the McIntire process, based on the well-known Smith "Carbocoal" process. They stated that the essential characteristics of an ideal domestic fuel were that it should be non-friable, smokeless, free-burning yet holding its fire and reasonably priced. These essentials seem to be met by the briquetted product of this process, over 5,000 tons of which were sold and used with satisfactory results last winter in Fairmont, W. Va., where the plant, owned by the Consolidation Coal Products Co., is located. The process involves three stages, primary carbonization, briquetting of the semi-coke, and secondary carbonization of the briquets, as did the Smith "Carbocoal" process. The new features are in the new primary retort, which has already been described in the technical press and in the new secondary retort, which will be described fully at some later date. In brief, the new secondary exposes the briquets, in layers of two deep to radiant heat from the top and bottom for a period of 30 minutes and has a capacity of 10 lb. of raw briquets per square foot of heating surface per hour at 1,000 deg. F, or about five times the capacity of a high-temperature coke oven though operating at one-half the temperature.

Professor Parr gave some details and showed some lantern slides of his two-stage low-temperature process, developed particularly for low-grade bituminous coals, in which the coal is first heated below the temperature of plasticity for a period and then introduced into a vertical low-temperature retort where it is subjected to a short period of carbonization. This process is said to have produced a satisfactory fuel and gas and a tar comparable to high-temperature tar, of which more was said in a later paper.

A paper by I. F. Laucks, describing the development of the Green-Laucks low-temperature process was read, indicating that the difficulties met with in this system of carbonizing coal while passing upward in a vertical retort, under screw propulsion, have been overcome. At present, satisfactory results have been obtained on a 36-in. diameter retort and the backers, the Old Ben Coal Co. of Chicago, are building a 9-ft. diameter retort.

Tests on Tars from Parr Process

A paper by S. R. Church, entitled "A New Type of Tar, Produced in Carbonizing Illinois Coals," recounted the results of carrying out routine tar tests on four samples of tar produced by four separate runs of the Parr retort on two different grades of Illinois coal. With each coal one run was made at approximately 700 deg. C. and another at approximately 800 deg. C. The tests were conducted in the laboratory of the University of Illinois at Urbana, Ill., by M. G. C. Coons and the author and followed the standard methods for tar testing advocated by the Barrett Co. Differences in characteristics attributable to the difference in temperature of carbonization were found, but these were of slight importance.

The remarkable point brought out by these tests was that, although produced at temperatures considerably below those prevailing in conventional gas retorts or by-product ovens, these tars possess the characteristics of the most desirable types of high-temperature tars, it being evident that the oils and pitches obtainable by ordinary methods of tar refining will meet the generally accepted specification requirements; e.g., the creosote meets the requirements of the American Railway Association No. 1 grade.

However, these tars differ greatly from tars obtained from other low-temperature processes, as far as available data show. This fact leads the author to conclude that it is not the maximum retort temperature that governs the character of the tar but rather that the temperature of the tar paths through the coal mass are what count. An important feature of these Parr process tars is the high content of tar acids falling within the boiling range of phenol and cresol rather than within the higher boiling range of tar acids from other low-temperature tars.

S. P. Burke and V. F. Parry in a paper on "Heat of Carbonization of Coal," pointed out that the engineer is concerned with the actual amount of heat necessary to carry on carbonization. In order to determine this, they devised a method comprising the carbonization of coal at constant thermal conditions without heat flow. Results proved that, at least for all the coals tested, carbonization is an exothermic process.

Concerted Attack Underway on Anti-Knock Problems

Holds chief interest of oil technologists at Philadelphia meeting of Petroleum Division, A. C. S.

Editorial Staff Report

APPROACHED from four directions by as many different investigators and research organizations, the several problems involved in the study of the anti-knock properties of motor fuel are receiving attention that promises results of direct interest to technologists in the petroleum and automotive industries and of indirect interest to a much larger automobile-driving public. At the meetings of the Petroleum Division of the American Chemical Society held in Philadelphia, September 7, 9 and 10 under the chairmanship of Ralph R. Matthews of the Roxana Petroleum Corporation, important papers on this subject were contributed by representatives from the laboratories of the Ethyl Gasoline Corporation at Yonkers, N. Y., the chemical engineering department of the University of Michigan at Ann Arbor, the Universal Oil Products Co. at Riverside, Ill., and the General Motors Research Corporation of Detroit. In all, 25 papers covering many phases of petroleum technology were presented at the three technical sessions, each of which was attended by more than 150 members and guests of the Division.

Dr. Graham Edgar, director of research for the Ethyl Gasoline Corporation, emphasized the fact that we have no absolute method of measuring the knocking characteristics of fuels. Since all consist essentially of measuring the comparative performances of two different fuels, it seemed highly desirable to develop a reproduceable synthetic fuel that might serve as a primary standard and permit a comparison of results of different laboratories and experimental methods. Dr. Edgar set about, therefore, to synthesize two compounds which when mixed in varying proportions would duplicate the knocking characteristics of any commercial gasoline. The first of these was normal heptane, prepared from pine oil. This exhibits the usual knocking tendencies of the paraffines. The other is a new synthetic octane $(CH_3)_2CCH_2CH(CH_3)_2$, which in contradistinction to the normal octane, has marked anti-knock properties. It is now proposed to utilize mixtures of these two hydrocarbons as primary standards in rating the knock characteristics of fuels.

"The Probable Cause of Detonation in the Internal Combustion Engine" was the subject of a paper by Professor George Granger Brown and Dr. G. B. Watkins of the Department of Chemical Engineering of the University of Michigan. Using a modification of the bomb method developed in the Michigan laboratories, these investigators seem to have confirmed the view that the engine knock is caused by some form of auto-ignition. It was found that if the maximum rate of rise of pressure in the type of reaction occurring in the bomb explosions under constant initial conditions be divided by the auto-ignition temperatures on the absolute temperature scale, a number is obtained which varies directly as the knocking tendency of that particular fuel in an engine or inversely as Ricardo's useful compression ratio for that fuel.

Commenting on the experimental results presented in the following table, Professor Brown said: "These data clearly indicate a different type of reaction in the engine than in the bomb. From direct photographic evidence the bomb explosions are known to be progressive homogeneous reactions. Therefore, detonation in an engine cylinder is due to a heterogeneous or at least a compound hetero-homogeneous reaction (auto-ignition). This contention is further supported by the fact that engine knocking may be eliminated by efficient cooling of the over-heated areas such as exhaust valves in the combustion chamber. This explanation of detonation in internal combustion engines is the first which seems adequate to explain the engine knock under all conditions and specifies two properties of fuels which determine their relative knocking tendency."

Fuel	Maximum Rate of Rise of Pressure	Auto-Ignition Temp. in Deg. Kelvin (Moore)	Product of Max. Rate of Rise of Pressure and Reciprocal of Auto-Ignition Temperature	Ricardo's Highest Useful Compression Ratio	Compression Ratio Calculated, with Toluene as Basis of Comparison
N-Hexane	47,500	560	84.8	80 per cent hexane 5.1	5.36
N-Heptane	61,500	554	110.8	97 per cent heptane 3.75	4.1
Benzene	63,000	893	70.5	6.9	6.45
Toluene	56,500	869	65.0	99 per cent toluene 7	7.0
Xylene	47,000	757	62.2	7	7.3
Methanol	52,000	779	66.7	5.2*	6.8
Ethyl alcohol (absolute)	39,500	668	59.1	98 per cent Et. Alc. 7.5	7.7

*Preignition occurred before audible detonation.

Effects of End Point and Treating

While it has been generally held that the higher the volatility of a gasoline, the better its anti-knock properties, automotive experiments carried on by Drs. Egloff and Morrell, of the Universal Oil Products Co., showed little actual difference in these properties on straight-run and cracked gasolines varying in end points from 388 to 430 deg. F. Their results for Cushing and California fuels in terms of benzol equivalents were as follows:

	Cushing Straight-Run Gasoline			Cushing Cracked Gasoline		
	Deg. F.					
End Point	389	412	427	393	411	430
Knock Point			Spark	Advance		
A	5.5	6.0	6.0	8.5	10.5	10.0
B	9.0	9.5	9.0	11.5	13.0	13.5
C	13.5	15.0	15.0	18.5	17.0	17.5
D	19.0	19.0	19.0	23.0	22.0	22.0
Benzol equivalent, per cent	0.0	0.0	0.0	10.0	8.0	8.0

	California Straight-Run Gasoline			California Cracked Gasoline		
	Deg. F.					
End Point	388	408	431	386	406	429
Knock Point						
A	13.5	13.5	12.5	18.0	15.0	14.5
B	18.0	17.5	16.0	21.5	18.5	17.5
C	24.0	22.0	21.0	26.0	24.5	23.5
D	31.0	29.0	20.0	28.0	25.0	24.0
Benzol equivalent, per cent	24.0	21.0	20.0	28.0	20.0	24.0

A second paper presented by Dr. Egloff showed that in acid treating a certain California distillate to bring down the sulphur content from one to 0.15 per cent, there was a loss in the benzol equivalent of about 10 per cent. This was in addition to the high loss due to the acid treatment. It was held that many such gasolines are overtreated with a tremendous economic loss of anti-knock properties as well of chemicals.

Three papers by Wheeler G. Lovell and John D. Coleman, associated with T. A. Boyd at the General Motors Research Corporation reported the progress of that organization's studies of combustion in the gasoline engine. Ingenious laboratory methods have been devised for determining the starting properties of motor fuels and the rates of burning.

Synthetic Rubber Unpromising Say Experts

Rubber Division meetings of A. C. S. clarify situation regarding synthetic rubber and domestic culture of guayule rubber

Editorial Staff Report

FROM 200 to 400 rubber technologists heard eminent speakers from home and abroad discuss problems of wide interest before the Rubber Division of the A. C. S. convened in Philadelphia Sept. 6 to 10. Papers from overseas were "Research on Raw Rubber at the Netherlands Government Institute at Delft," by A. van Rossem, director of the Institute; "Developments on the Dutch Rubber Plantations," by Otto de Vries, director of research, Dutch Rubber Plantations, Delft; "The Direct Use of Rubber Latex, with Special Reference to Vulcanized Latex," by P. Schidrowitz, London; "The Dissection of the Latex Globule Recorded by Micro-Motion Pictures," by E. A. Hauser, Frankfort, and "Synthetic Rubber" by Dr. R. Weil of Germany. Unfortunately, H. P. Stevens, consultant of the British Rubber Growers Association, London, was taken ill shortly after his arrival and was forced to return to London.

Liberia Offers Opportunities for American Rubber Planter

Speaking on "The Importance of Rubber in Modern Civilization," E. E. Slosson, director, *Science Service*, Washington, D. C., remarked that political control of rubber-producing territories is not essential to the plantation operations of American companies. Two of the most promising territories for American rubber interests appear to be South America and Africa. In Africa, Liberia is particularly attractive since it has been virtually under the wing of the United States from the first. Liberia would be an admirable outlet for the better educated class of colored people, as their opportunities there would be unlimited and they would probably be much better adapted to the tropical climate than white peoples. Dr. Slosson said that British rubber growers deserve full credit for their courage and business foresight in development of plantations; and that American interests have no cause for complaint at the present price-fixing as determined by the Stevenson Act. The synthesis of rubber itself on a commercial scale appears to be unlikely, but the chemist may produce something far better, said Dr. Slosson.

Synthetic Rubber Is Low Quality, High Cost Product

W. C. Geer, vice-president, the B. F. Goodrich Co., Akron, Ohio, read a paper by Dr. Richard Weil, an eminent German rubber chemist, on "The Present Status and Future Prospects of Synthetic Rubber." During the war, Germany made 2,350 tons of "methyl" rubber, which is obtained by polymerizing dimethylbutadiene. In the preferred process, polymerization requires about 5 months at 70 deg. C. Such rubber lacks plasticity and a large proportion of fillers is necessary to obtain a workable material. Methyl rubber is satisfactory for hard-rubber compounds and for cable insulation, but it lacks elasticity when compounded by any ordinary formula. Doctor Weil believes that isoprene rubber is the most promising of the synthetic products, and that future research will be justified even if only a small part of the demand could be satisfied. This would tend to stabilize rubber prices, he said. Doctor Geer commented that the present commercial failure of synthetic rubber is due to (1) the poor physical properties of the product, (2) lack of knowledge regarding the elasticity of rubber as related to structural formulas, either for the natural or synthetic product, and (3) the high cost, low yield and multiplicity of steps in the process. The trend of research should be on the perfection of natural rubber culture and modernization of rubber harvesting and processing, rather than on synthetic processes, believes Doctor Geer, and it is difficult to believe that synthetic rubber can compete with the cost of really efficient natural rubber. Present plantation operations, particularly the mechanical ones of clearing jungle-land, tapping, coagulating, washing and drying are inefficient. Furthermore, as only 7,000 sq.mi. is now under cultivation, the opportunities for future plantation expansion are practically unlimited.

Guayule Rubber Has Promising Future

All aspects of guayule rubber, botanical, chemical and economic, were presented in a series of papers from the Intercontinental Rubber Co. W. B. McCallum, botanist, described results of 14 years research on the guayule plant. Culture from seeds has been mastered, although for years failure seemed inevitable, as germination is slow and the young plants are extremely delicate. Guayule matures in 5 years to a dry weight of from 1 to 20 lb., although 2 to 3 lb. is the more usual size. The rubber content on the bone-dry basis is from 14 to 16 per cent, as contrasted with about 0.5 per cent by dry weight in the hevea tree. In consequence, the annual yield per acre from guayule is comparable to that from hevea.

Guayule is a hardy perennial capable of resisting short periods of cold, even as low as 5 deg. F. It thrives in southern California and northern Mexico, and as many as 5,000,000 plants have been grown in one season in the California nursery of the Intercontinental Rubber Co.

David Spence, vice-president of the same company, reported investigations on the deterioration of guayule during storage. Even several weeks is sufficient to oxidize or depolymerize a considerable part of the rubber content. Prompt extraction of the rubber, preferably by mechanical methods, is therefore desirable, and much progress has been made in developing a quick, efficient and low-cost procedure for separating the rubber-containing cells from the fibrous material and resins. As the rubber from guayule is in solid form—not as latex—the shrub is successively crushed, pulverized in tube mills, and most of the rubber is separated by flotation. The remaining admixed fiber is separated by water-logging by pressure and heat followed by beating. Guayule rubber, compounded in the usual way, had properties comparable to hevea. When properly processed, it is not in any sense an inferior product. In fact, its compounds are typically soft but high in tensile. G. H. Carnahan, president of the Intercontinental Co., concluded the discussion of guayule by describing production methods.

Further abstract accounts of the Rubber Division papers appear on p. 528 of this issue.

Use of Ball Bearings in Motors

Freedom from maintenance troubles, decreased power loss and ability to withstand hard service are advantages realized

APPLICATIONS of electricity to the chemical engineering industries fall into three principal classes: machinery drive, electrolytic processes and electrothermal processes. Each class has had very far reaching developments in the last score of years, though their relative importance as applied to particular industries depends upon their own peculiar processes. Taking them generally, the most extensive use of electricity is motor drive of machinery.

This wide use of electric drive is due to the general recognition of its advantages, which require only casual mention. Briefly they are: Simple and direct drive wherever power is needed; ease of control from convenient points; more constant speed and greater reliability, both yielding increased production; usually lower cost of power; better illumination, working and general plant conditions because of reduction of shafting and belting.

Adverse Conditions Often Met

The conditions under which motor drive must render reliable and efficient service are as varied as the chemically controlled industries themselves. Very commonly they involve one or more conditions of severity, especially as to environment, that are uncommon in ordinary industrial plants. While some motors have a rather severe operating duty, due to violent fluctuations of load or frequent starting, stopping and reversing, as with motors for jaw crushers, skip hoists and furnace chargers, the more customary operating conditions are not severe. Probably the largest percentage of motors in the industries under consideration operate for long periods at substantially constant speed and relatively steady load.

As to the surroundings under which the motors work, the conditions are apt to be much more severe than in ordinary factories or mills. The presence of dense dust is commonly encountered in crushing, grinding and dry mixing departments. These dusts are injurious in various degrees. Some are heavy and adherent and cannot readily be blown out of motor windings; others are flammable or possibly explosive and for safety must be entirely excluded from the motor by complete inclosure of the latter. Even if the dust is inert its presence hinders the dissipation of heat, it is liable to work into ordinary bearings and play havoc therewith, and, if the motor has a commutator and brushes, it will cause endless commutation troubles

The motor may be subject to drippings or splashings of water, alkaline or acid solutions or other liquids corrosive to the windings and motor frame or damaging to the insulation. A protecting cover over the motor may suffice, though more likely specially insulated windings, additional protection on the end turns, or perhaps a completely inclosed housing and corrosion-resisting exterior finish will be needed.

Gases or vapors of a deleterious nature are not uncommon in chemical plants. Their injurious action may be corrosive like that of the liquids just discussed, or it may be explosive with a certain admixture of air and heat like that of many volatile hydrocarbons. Complete motor enclosure is usually desirable in all dangerous cases. To protect effectively against the destructive agencies referred to involves some addition to the first cost of the motor, unless the other choice is followed of buying a cheaper motor intended for ordinary service and paying for greatly increased maintenance throughout its useful life. Even then there will remain the question whether the added maintenance will be dependably rendered so as to insure the reliability of the motor drive that is expected.

Maintenance Problem of the Ordinary Motor

Any motor, like any other machine, requires more or less maintenance in order to function as intended. If the motor is safeguarded from injurious surroundings and has no sliding contacts, the maintenance problem will be reduced to lubrication which can be neglected only at the risk of overheating and excessive wear of bearings that may result in their "freezing" or the striking of rotor and stator, in either case with a burnout and long shutdown for repairs.

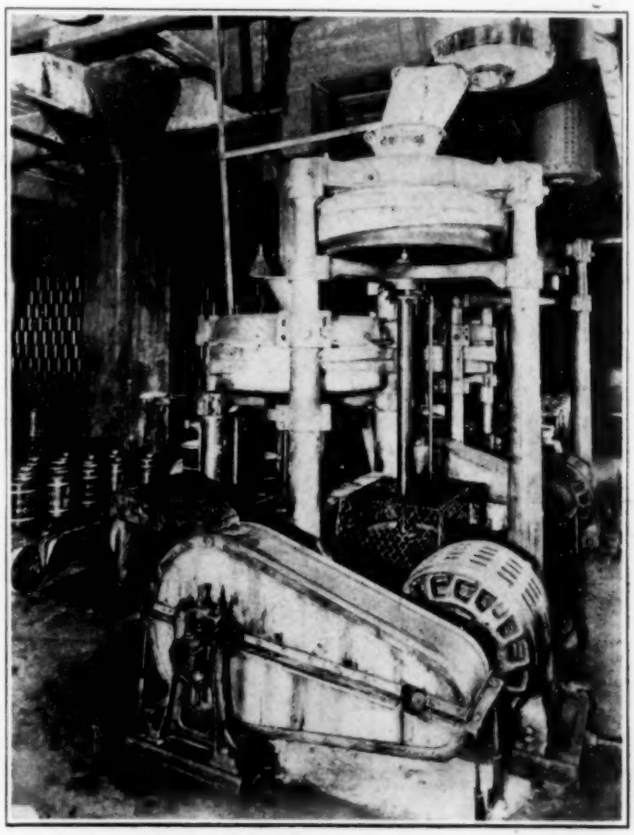


Fig. 1—Ball-Bearing Motors in the Paint Plant
These machines are driving mills used in the grinding of white lead

With sleeve bearings oiling is necessary at intervals of from less than a week up to a month, depending on the motor size and nature of its load and bearings. Not only must fresh oil be added to make up for that which may have leaked out, evaporated or become gummed, but the whole bearing must at regular times be thoroughly cleaned of old thickened oil containing worn metal. All surplus oil must be carefully wiped off.

Many motors are hung from ceilings or bracketed to walls or columns high above the floor. Lubrication of these motors and others difficult of access usually involves hazardous use of ladders. Because of the difficulties under which the motor oiler often must work, he is likely to shirk the job. At best, a year's total lubricating expense of an ordinary motor, including labor, oil and incidentals, is quite an item in the total upkeep.

If the motor is a direct-current machine its commutator and brushes may require attention every week or two under favorable circumstances, or oftener if there is dust, lint or oil to contend with. Neglect of proper commutator maintenance is so prolific a source of motor trouble that it offers another important reason for the preference given to polyphase alternating-current motors aside from the economy of transmitting alternating-current power to any part of an extensive industrial plant.

Reverting to the possibility of combating injurious surroundings of a motor by frequently dusting it off and wiping it clean, instead of positively protecting it by some of the methods already mentioned, in some cases the former alternative is entirely impracticable. Even where it can be done more or less effectively, it will usually increase the maintenance cost to a prohibitive figure. There will remain the continual risk that slight neglect may result in a breakdown at a critical time.

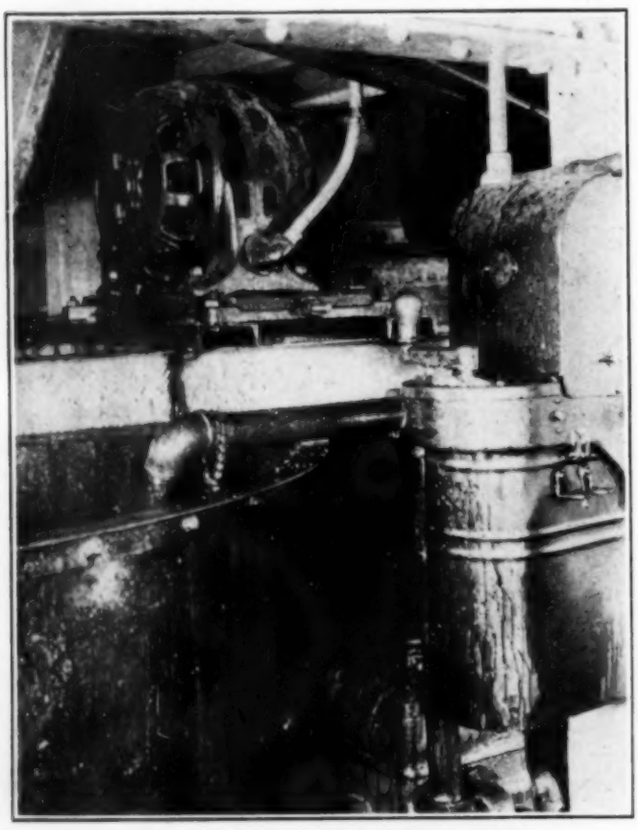


Fig. 2—Ball-Bearing Motor Exposed to Oil

This motor is provided with special insulation to withstand the continual soaking in oil to which it is subjected

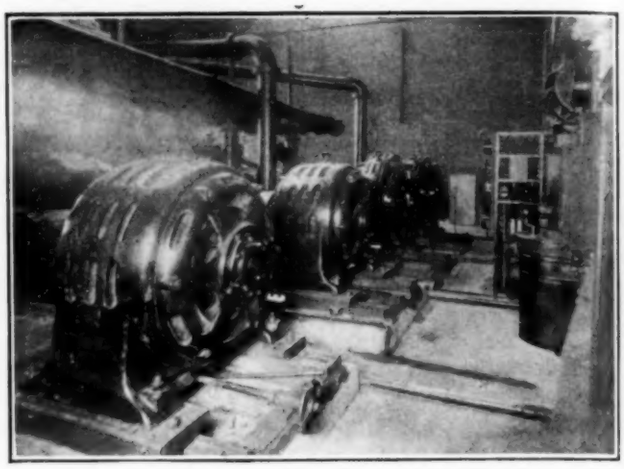


Fig. 3—Ball-Bearing Motors in the Paper Mill

This group of motors are driving Jordan engines, a service requiring ability to withstand shock

Continuous Processes Require Most Reliable ane Efficient Motor Drive

Chemical and metallurgical plants frequently employ processes operating continuously for many days or weeks at a time. Such operation often improves the quality of the product, makes possible important operating economies, and in all cases results in full utilization of plant facilities and brings greatest return on the capital invested. To insure these highly desirable benefits necessitates use of the most reliable equipment for every element of the process. Failure of a unit may stop everything all along the line and at least may check production, if not spoil an entire batch of product. By care in selection of the equipment the most rugged and properly safeguarded machinery can be chosen and failures in service practically eliminated.

Another very desirable feature in equipment, especially that which operates continually over long periods, is power efficiency. This feature has long been recognized by power companies in the selection of transformers of the highest possible all-day efficiency for service where they are continually connected to the lines. It is equally important for motors. A gain of even 1 per cent in efficiency will bring power savings that represent a substantial return on the slightly increased investment in the more efficient motor equipment.

General Features and Merits of Ball-Bearing Motors

The motor requirements of the chemical industries as just reviewed are said to be fully met by the ball-bearing motor. This type was developed for standard production 14 years ago by Fairbanks, Morse & Co. In recent years ball bearings have been adapted to many kinds of machinery with highly satisfactory results in efficiency and upkeep. Their record of 14 years on electric motors shows that what some at first regarded as a delicate refinement in motor building is really an important element of ruggedness and dependability in service.

In ball bearings there is a continual free rolling action between the moving parts. As rolling friction is but a small fraction of sliding friction between

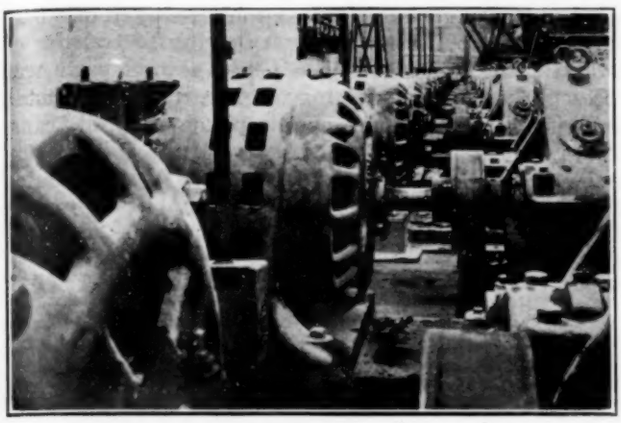


Fig. 4—Ball-Bearing Motors in Linoleum Plants
A group of grinding machines used in preparing the plastic mixture is driven by these motors

similar surfaces, the first benefit of ball bearings is a substantial reduction in both starting and running friction as compared with sleeve bearings. Since all friction losses are converted into heat, the ball bearings run much cooler at all times. Their power-transmission efficiency is always higher than that of sleeve bearings, especially when running at a fraction of full load.

Ball bearings are nearly always packed with grease that adheres to the balls and races so that no bare metals ever come into rubbing contact. In sleeve bearings the oil film that should be maintained between journal and sleeve is sometimes broken, as when starting in very cold weather with stiff oil or when running at very high speed so that insufficient oil is fed to the sliding surfaces; rapid heating then results, and, if an attendant is not at hand to stop the machine immediately, burnout of the bearing will occur. This is practically unknown with ball bearings.

Reference has already been made to the considerable time, cost and trouble required for the frequent oiling of ordinary bearings. Many years' experience shows that 20 minutes once a year suffices for the lubrication of a ball-bearing motor. The top plug of the bearing is removed and the bearing filled with kerosene; the motor is run for a few minutes, the bottom plug then opened and the dissolved old grease drained off. Fresh grease is then put into the bearing until it is about three-fourths full. A recent improvement provides the grease in collapsible tubes, each holding the correct amount of grease for lubricating a particular size of motor. This permits squeezing directly into each bearing just enough clean grease for the best results. The entire job is very simple and economical.

The chamber containing the ball bearings is completely sealed and under normal conditions the grease does not liquefy, so there is no tendency for it to flow out and soil the motor or surroundings. By contrast, oil from sleeve bearings often seeps along the shaft and accelerates breakdown of the insulation by collecting on the windings. It often flows over the bearing housing, forming with the dust a greasy sludge on the motor, or dripping on machinery or places where it may spoil much product or make slippery oil-soaked floors.

Complete sealing of the ball bearings not only prevents the grease escaping therefrom, but it protects them against the entrance of dust, water, oil or other injurious matter. Instead of being one of the most vulnerable parts of the motor, the ball bearing is one of its rugged features. As far as the bearings are concerned, the motor is entirely immune to any injurious surroundings.

There being practically no wear in ball bearings, the air gap between rotor and stator remains uniform, which is an important feature in maintaining the initial efficiency. Likewise, in direct-connected electric pump or blower sets equipped throughout with ball bearings the shaft runs in accurate alignment on permanently true centers, thus maintaining the designed clearance between wearing rings and impeller and keeping the efficiency at its highest point.

Other advantages follow from use of ball bearings. One is that they make it practicable to use a larger and shorter shaft, which obviously is more able to withstand sudden shocks or continual vibration due to the load and thus gives a more sturdy machine. The shortened length of the motor also enables it to fit better into cramped quarters.

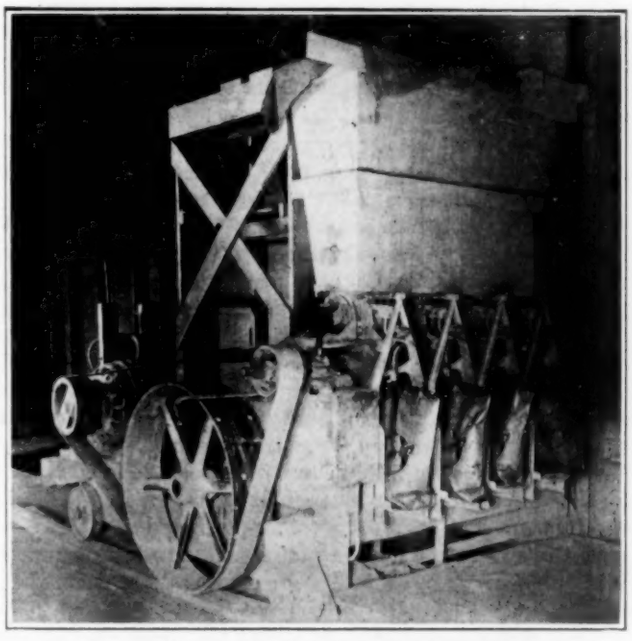


Fig. 5—Ball-Bearing Motors in the Lime Industry
Here the motor is exposed to the dusty conditions inherent to the operation of bagging

Uses of Trimethylamine and Dimethylamine

Research on the manufacture and uses of trimethylamine and dimethylamine has been carried out by Dr. D. K. Tressler and his assistants at Mellon Institute, Pittsburgh, Pa., who have perfected a new process of manufacture that will greatly reduce the cost and make large quantities available.

The principal use of dimethylamine is in the manufacture of rubber accelerators. It is an attractant for the cotton boll weevils and may find use in the preparation of poison baits. Trimethylamine or mixtures of trimethylamine and dimethylamine may be used for the same purpose. Both trimethylamine and dimethylamine may be used for the preparation of methyl chloride.

Trimethylamine has been suggested for use in the preparation of potassium carbonate according to a process resembling the Solvay process for the manufacture of sodium carbonate.

Welded Structural Steel Work

Demonstrating the application of engineering principles and procedure control to oxy-acetylene welding of structural steel

By H. H. Moss
Linde Air Products Co., New York, N. Y.

DURING the month of April and May of this year, a series of tests were conducted at the Buffalo shops of the Linde Air Products Co., on some oxyacetylene-welded steel roof trusses. These tests were preceded by studies of this problem during several years, made by this company's process development department. A practical and sound method for fabricating structural steel by oxyacetylene welding was sought and interesting and constructive results have now been obtained.

As a basis for initial study one of the company's standard building structures was selected; the design of the details could be experimented with in the laboratories; furthermore we could build the trusses and place them in a new building, thus translating preliminary studies into practical service. This structure provided a one-story building, with roof of 40-ft. span having the usual one-quarter pitch without monitors.

Initial studies produced what has been termed "Insert Plate Joint." It was developed while trying to place web metal concentrically around center lines in a theoretical diagram and by adding long steel rectangles on either side of this web metal to obtain sufficient area and rigidness for a practical structure.

Angles, tees, and tubular sections were tried with this idea as a basis for joint design. For each shape an elementary truss design was studied, thus determining the style of the joints that must be developed to complete a truss structure. An ideal joint is shown in Fig. 1.

The next and obvious problem consisted of transferring the full strength of members having lateral metal into the web plate or into a single flat plate somewhat as shown in Fig. 2.

This sketch suggested the insert plate design. While the intended scope of this article does not permit a full account of this development (nor indeed can this be correctly defined until further investigations are made) a typical application as used in this test series is illustrated in Fig. 3.

It will be observed that a portion of the leg of members *a*, *b*, and *c*, has been removed. An insert plate, fashioned as shown *d*, *e*, *f*, *g* . . . placed in the plans of the longitudinal legs of the tee-shaped members *a*, *b*, and *c*, supplies the necessary metal for transfer of stress at the joint. Union of these several parts was accomplished by butt-welding where metal joined metal, the result being a homogeneous plane of metal transferring the applied forces by means of welds in tension and shear in members *a* and *c*, and in compression and shear in member *b*. Briefly such a design provides several advantages:

1st — Center of gravity lines of the members converge exactly at the true intersection points.
2nd— All principal welds are placed at or very near to the center of gravity of the member joined.
3rd— The major portion of the welds function in shear.
4th— All metal is joined with butt welds.
5th—All metal joined may be placed symmetrically in regard to the axial plane of the main structure.
6th— A non-rigid weld at the terminal of each member.
7th— Easy means for rounding out the weld ends or filleting the finish (as shown by the dotted lines in Fig. 3) thus avoiding abrupt angles.

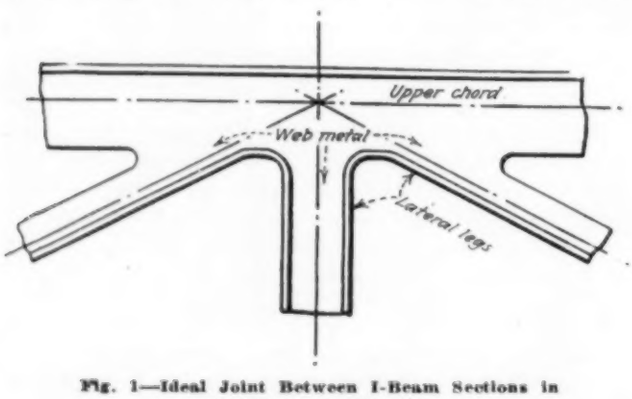


Fig. 1—Ideal Joint Between I-Beam Sections in Roof Truss Construction

Preliminary Work

First, a series of tests were conducted in the Carbide and Carbon Research Laboratories in Long Island City, on typical joints. Specimens were set up in correct fixtures in an 100,000-lb. Olsen tensile machine and pulled to rupture. In each the base metal of the adjoined member failed, at some distance from the tension weld in the insert plate—an evidence of the strength of this type of joint. Unit tensile strength developed in these tests averaged 56,000 to 57,000 lb. per sq.in., or approximately the average maximum strength of rolled shapes. There was no distress noticeable in the welds at the time of failure of these specimens. The material used was standard angles bought from a local warehouse. The filler rod or deposited metal was Oxweld No. 1 High Test Rod, the quality of which develops the full strength of the base metal across properly made butt-welds in mild steel.

These results proved that by using proper filler rod material the strength of the out-board legs of a member could be transferred into the insert plate. The assumptions for the plate design consisted of adding plate metal from the point of origin of transfer (point *a* in Fig. 2) proportional with the amount of shear increment transfer along the shear leg of the weld. An arbitrary additional amount of approximately ¼ in., was made to this width, as shown dotted in Fig. 2, to insure of ample strength. At the present time the straight-line principle of metal (or stress) transfer is being used, subject to modification as our experiments on this detail progress.

Among others, the unknown factors remaining in the problem consisted of:

1st — Proving the efficiency of the insert plate design in a practical structure and under shop conditions of welding.
2nd— Determining the feasibilitiy of the design embracing a complete truss structure.
3rd— Determining how the residual stresses due to welding (if any) affect a truss structure.
4th— Comparing the cost with riveted construction.

Design

Having as a background the preliminary insert plate design and the results of the specimen tests, complete designs were prepared for a series of trusses of 40 ft.

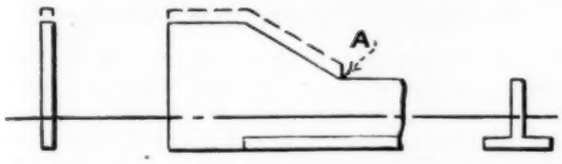


Fig. 2—Study of a Joint Between a Structural Shape and a Gusset Plate

span, one-quarter pitch, spaced 15 ft. center to center, to withstand a load of 40 lb. per sq.ft. of horizontal projection. Due to the method of testing, all loads were disposed vertically at each panel point and summed up to 3,000 lb. per panel, there being seven panel points of concentrated loading not including those immediately above the end supports. From these loads the working stress for each member was determined.

For comparison it was necessary to study a riveted truss, designed and built from the same specification. Both design and fabrication were done by a reputable concern, which furnished the truss material for both the riveted truss (Case 2, below) and its direct competitor (Case 3) all of which material was secured from the same rolling, and the physical properties of which were recorded. The yield point of this steel averaged 40,000 lb. per sq.in.

The several trusses, with the exception of the tubular one, were similar with respect to the upper and lower chords, being composed of two 3x2½x¼-in. angles and two 2x2x¼-in. angles respectively. The top chord angles of the welded trusses were placed tightly back to back, whereas in the riveted truss these angles were spaced apart ¼ to ⅜ in.

Case 1—Welded—Preliminary test truss. This truss had an identical member design as Case 4, with the exception that the main strut was made of two 3x2½x ⅜ tees. This truss was welded in quarters, then in halves (each side of the ridge joint). Afterwards field joints were made at peak at a third point in the lower chord. Gusset plates: ½ in., made up of two quarter inch plates.

Case 2—Riveted—Main web diagonals from ridge to field splice at lower chord two 2x2x ¼-in. angles. Main web strut; two 2½x2x¼-in. angles. Sub-strut: one 2x2x¼-in. angle. Sub-tensional diagonal: one 2x2x¼-in. angle. Gusset plates: ¼ in. and ⅜ in.

Case 3—Welded—The same composition and disposition of angle-iron members. Gusset plates ½ in., made up of two ¼-in. plates, each welded into the ¼-in. legs of each member at a joint.

Case 4—Welded—The same composition as Case 2, with the exception that the main web tension diagonals were two 1½x1½x ¼-in. angles. Sub-struts and subtensional diagonals: two 1½x1½x¼-in. angles.

Case 5—Welded—Tubular Sections. Upper chord: 3 in. nominal size standard black pipe. Lower chord: 2½-in. Main strut, 2½ in. Main tension diagonals, 2 in. Remaining web members 1½ in.

Welding Procedure

The first item under this heading consisted of testing the welders. The welders selected for this work were required to make welds in structural steel developing a minimum tensile strength of 50,000 lb. per sq.in. The results using high test filler rod averaged 60,000 lb. per sq.in.

The welding procedure governing cases three, four and five consisted of first welding the insert gusset plates into the principal truss members, after which these members were straightened where necessary, by the aid of a heating torch. Next, the partially welded members and the remaining web members were assembled into the truss form, clamped together and tack welded. By the aid of a cardboard angle template, proper alignment of the truss was maintained. The final welding progressed from this point. This procedure proved to be the most practical and was adopted after experimenting with several procedures with Case 1. Due to the use of two 1¼-in. insert plates at each joint, double "V" welding was approached as each truss half after being welded throughout on one side was turned over and again welded on the opposite side.

Summary of Load Tests

Tests were made by loading the trusses to failure. In each case typical column failure of the upper chord between panel points occurred. Three cases failed at the rigid end of the truss and two failed at the free or movable end. At no time throughout these tests was there any indication of joint distress. Approaching failure, by passing the maximum strength of the upper chord was evidenced by Luders lines appearing in the cement coating. In the riveted and tubular trusses these distress signals appeared before the 9,000 lb. panel load was reached.

The loads and factors of safety developed in each case, the weight of each truss and the recorded reflections up to 9,000 lb. panel load are given in the following table:

SUMMARY OF RESULTS

Mark, Case	Kind of Truss	Comparable Weight of Trusses, Lb.	Max. Panel Load, Lb.	Factors of Safety Developed	Average Deflection 3,000	6,000	9,000
1	Preliminary truss, welded.	1,199	10,285	3.42	0.28	0.62	1.03
2	Riveted truss.....	1,161	9,000	3.00	.29	.635	....
3	Direct competitive welded	1,079	10,318	3.44	.25	.585	1.095
4	Symmetrical truss, welded	1,079	10,043	3.34	.335	.695	1.13
5	Tubular truss, welded....	916	8,877	2.96	.285	.655	....

Results of these tests, which afforded splendid opportunities for observing the habits of welded construction under conditions of extreme stress, point toward a still greater saving in metal in all members below the top chord. Furthermore, the theoretical amount of metal

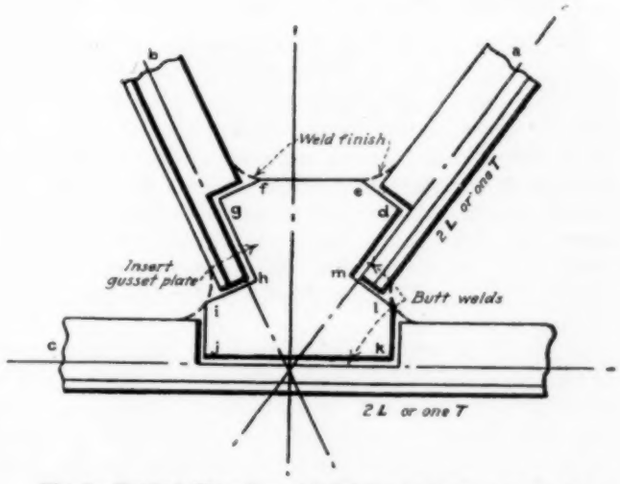


Fig. 3—Typical Plate Insert Joint for Angle Iron Sections

can probably be used in the secondary web members, now generally heavier than necessary to take the stresses, without causing difficulties as far as welded fabrication is concerned. However for uniformity of the welded joint a minimum thickness of ¼ in. seems to be desirable for this type of structure.

Further investigations along this line are now being made and a 6th case, designed from the same load specifications governing the previous five, will be developed. This case will utilize rolled tee sections in all tension members and in the sub-struts, having areas agreeing closely with the theoretical requirements and joined by the insert plate method.

Conclusions

It is quite apparent that the insert plate joint is a step in the right direction towards the solution of the problem of joining structural steel by oxy-acetylene welding.

Fundamentally and practically, this method of joining is sound.

The summary in the table shows a rigidity in favor of welding of approximately 15 per cent. This may be explained in part on the assumption that the "fixation" of column members is better than where the end connection is riveted. The reader's attention is again called to the fact that the upper chord angles in all welded trusses were placed tightly back to back, which would be expected to lower the lateral strength of these columns as compared to angles spaced slightly apart.

Material saving in weight of steel necessary for a structure of this type can be made, compared to the present methods of fabrication.

Welding by this method does not inject negative factors of strength in a completed truss structure, nor in the base metal adjacent to the welds. This is evidenced by both the load tests and the strain gage work.

The shop work proved to be simple and attended with but few minor difficulties which were easily remedied Good alignment of members was maintained by following recognized welding practices. In doing work of this nature, it is recommended that adherence be made to a correct procedure control. In brief it summarizes as follows:

a—Selection of Workmen
b—Purchase of First-class Materials
c—Provision of Good Shop Conditions
d—Correct Engineering Design for Welding
e—Adequate Supervision and Management
f—Inspection and Proof Test

By observance of this code, progress in the field of welded fabrication of structural steel can be expected. Caution, and by all means engineering control, on this class of work is imperative. Much remains to be done along these lines, from an engineering and proof testing standpoint before the welding of structural steel will enjoy the confidence of the progressive structural engineer and fabricator. The welding engineer however, finds much encouragement when witnessing results in practice that conform so closely to his theoretical predictions.

Acknowledgment is gladly made for suggestions made in informal conference with members of the Bureau of Standards, for aid and encouragement from G. O. Carter, Consulting Engineer of The Linde Air Products Company, and for the facilities freely given by W. S. Roberts at the Buffalo Engineering Laboratory.

Porcelain Enameling Furnaces

In a recent issue of *The Metal Industry*, R. A. Weaver gave some information on the construction of furnaces for porcelain enameling. He said in part:

At the base of an enameling furnace is a concrete foundation, approximately eighteen inches thick. Then come four or five courses of cull brick, on top of which are four courses of fire brick. This brings the furnace up to the bottom of the combustion chamber. The outside of the furnace is ordinarily built up of nine inches of red brick.

In the furnaces made by the Ferro Enamel Supply Company, the salt glazed brick, which has many of the good qualities of fire brick, is used for the outside. Inside of these brick are nine inches of Sil-O-Cel insulation, using their standard brick. Inside the insulation they use nine inches of a good grade of fire brick. Piers, which line the combustion chamber and which support the muffle, must be of a very good quality to withstand the action of the oil or gas burner and the great heat at that point. This company has found that Crystolon brick, made by the Norton Company of Worcester, Mass., is the best for their purpose. This is a product which does not melt even at a temperature about 4,000 deg. F., and has great physical strength, hot or cold.

Under old conditions the clay muffle was fairly satisfactory because the work was usually projected into the enameling furnace on a two-wheel tilting fork and no great production was required. Under the modern demands for large quantities of porcelain parts, however, it was necessary to work out various schemes to increase production. One scheme was to use two forks on a movable carriage so that one fork could be loaded while the work from the other fork was being enameled. Naturally, this resulted in greater heat losses on account of the increased number of cold loads which were being put into the furnace. This meant that the furnace had to be improved in different ways. In the first place, it was necessary that no heat be lost through the walls, so increased insulation was necessary. Next, it was necessary that the heat from the combustion chamber and the flues be transferred to the inside of the muffle as rapidly as possible in order to take care of the cold loads, which were being put in. Clay muffles would not transfer this heat fast enough, so a better refractory had to be found. A few years ago the question seemed to be solved by silicon carbide muffles, but under certain conditions these had a tendency to "grow." At this time the Ferro Enamel Supply Company is using a fused alumina product, made by the Norton Company and called Alundum. This has the increased heat transmission qualities which were desired, does not "grow" and will withstand the high temperatures which we use. As a matter of fact, on account of the splendid heat transmitting qualities, it is not necessary to use as high a temperature in the combustion chamber.

One feature in the design of these furnaces is the patented Manion "V" bottom. The enamelers formerly used either the flat or arched bottom. In order to support their work, they would then build up what were called "pigs" or supports for the cross bars which held the work. In these furnaces the bottom itself is composed of three inverted "V's," which provide about 50 per cent more radiation surface in the bottom than either of the old types. At the same time, the cross bars, which support the enameled parts, are in turn supported directly on the "V" bottom.

Refractory Articles from Tungsten Powder

Preparation and properties of crucibles, rod and tubes for high-frequency furnace work.

By J. Härdén
Metallographic Institute, Stockholm

WITH the advance of high-frequency heating, now popular in high-temperature research, there has been need of a crucible or container with a fairly good electrical conductivity, and a high melting point, but containing no free carbon—which would react with the melt—i.e. a suitable substitute for graphite. The author, having been working for some time with a high-frequency melting equipment, the capacity of which was limited, found some difficulties in obtaining uniform melts of iron alloys, due to the bridging over of a part of the melt at the top of the crucible. This is entirely overcome by the methods to be described.

Other instances may also occur in which objects of similar properties would no doubt be convenient, for instance to replace carbon tubes or iridium tubes in small furnaces for heating to elevated temperatures in vacuo, and the like. See Felse (*Zeitschrift für Techniche Physik*, 1924, p. 473). A tungsten tube, 10 cm. in length, 1.2 cm. in diameter, is made in such a way that a square rod is pressed from tungsten powder, preheated, then drilled and turned into tube shape and sintered.

Of course rods, etc., can easily be had from tungsten filament factories; but other shapes would be difficult and expensive to obtain from that source, therefore it appears desirable to be able to make them by the following method:

Ordinary commercial tungsten powder of good quality (98.5-99.0 per cent metallic tungsten, chief impurity being tungstic oxide) ground to 80 to 90 mesh, is used as raw material. A suitable quantity is placed in a flat porcelain mortar and sprinkled with a small quantity of lukewarm water and well mixed; after this, about 10 to 12 per cent of a warm solution of 25 per cent glucose in water is gradually added, while the mass is vigorously kneaded, until it feels plastic and can be pressed into balls.

It is essential that each particle of tungsten powder be well coated with a film of glucose solution, as otherwise the finished article will show cracks. For this reason it is better to add a slight surplus of glucose, and stamp the mass (after being well kneaded) in a tubular mold and extrude, after which it is slightly heated (to about 60 to 80 deg. C.) for a few minutes on an iron plate. Other binding substances were also tried, such as starch, gum tragacanth and dextrin, but glucose was found to work best.

After this preparation, which makes the mass more plastic, this now semi-plastic mass is placed in a mold, which, for crucibles, is shaped as shown in Fig. 1, in which *a* is a cylinder of cast iron or steel, *b* a pestle slightly cone-shaped, *c* a counter-pestle. The mold should be slightly greased with oil, glycerine or fish glue. The mold is placed with pestle *b* downwards on the table, the mass tamped in, filling the space *e*, preferably with a piece of iron pipe. Between the mass the pestle *c* a tight-fitting steel plate *d* is placed, preferably also a disk of thin paper which is necessary as the removal of the crucible from pestle *c* is difficult and may spoil the appearance. The mold is placed in a press, giving about 25 to 50 kg. per sq.cm. Hammering with a large hammer is sufficient, if no press is available.

It is not advisable to place the mass in a lump on top of pestle *c* and try to force down the pestle *b*, since the mass is too gritty to yield. Pestle *b* is now withdrawn by turning and the crucible pushed out and set on a plate to dry. The plate is gradually heated to about 350 to 400 deg. C.

In this condition, the material is comparatively hard and may be handled safely. If heated to about 600 deg. C. in a non-oxidizing atmosphere and cooled, it may be drilled, filed and turned in the lathe, even screws may be cut if some care is taken, although it is still brittle. See right-hand piece in Fig. 2.

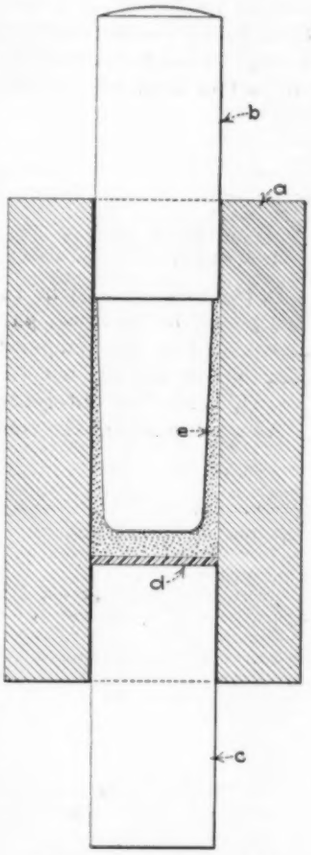


Fig. 1—Mold for Crucibles

The molded article is now placed in a carbon-tube furnace and fired to at least 1,600 deg. C., when it becomes hard and durable. The hardness is varying—the grains being very hard—so that the edge will easily scratch glass.

The formation of tungsten carbide is dependent on the time of heating, as will be shown, as well as on the temperature. According to some investigations by A. Westgren and others, Mennicke [*Die Metallurgie des Wolframs*, p. 261, Berlin (1911)], the lower carbide containing about 3.1 per cent carbon is quickly formed by heating to about 1,500 deg. C., while the higher carbide, containing about 6 per cent C, forms by prolonged heating.

The articles show a grey metallic color; when ground on an emery wheel, the surface shows a bright metallic lustre intermingled with darker spots. The shrinkage from unfired to fired state varies somewhat with the pressure applied, but shows an average of 1.6 per cent. When heated for 20 min. at 1,650 deg. C., the average specific gravity was found to be 12.82; when heated for 2.5 hr. at 1,600 to 1,800 deg. C., the specific gravity was in average 12.21, which indicates the formation of the higher carbide. The specimens were coated with a thin film of solid paraffin before immersion in water for specific gravity test.

If the theoretical specific gravity of the carbide WC is given as 15.7 and W_2C as 16.06 or a mean value of 15.38 for both, the apparent density of the material described would amount to 83.3 and 79.4 per cent respectively, dependent on the time and degre of heating. See Williams (*Compt. Rend.*, 1898, Vol. 126, p. 1722), also H. Mennicke *l.c.* p. 261.

The specific resistance was determined on two rods No. I and II, prepared as above and heated for 20 min.

Fig. 2—Molded Refractory Shapes of Tungsten Powder

at 1,600 deg. C., then heated again in fine charcoal powder for 2.5 hr. at 1,650 to 1,800 deg. C. The resistance, which was determined by sending a current of 1 to 4 amp. through the rod and observing the potential between two steel edges, was found to be:

Test	Specimen	Length, Mm.	Area, Sq. Mm.	Microhms per Cu.Cm. Mean Value
(*a*) heated to 1650 deg. C. 20 min.	I	34.0	64.32	21.02
	II	30.5	66.76	20.90
(*b*) re-heated to 1,650 to 1,800 deg. 2.5 hrs.	I	34.0	63.61	43.90
	II	30.5	66.47	33.50

In the instance (b) by re-heating, the specimen No. I was placed in the lower part of the furnace, and No. II above, and as the temperature was higher at the bottom than at the top, No. I became more carburized than No. II, hence the difference in specific resistance.

As a comparison, the following figures may be given:

Substance	Microhms per Cu.Cm.	Reference
Soft iron	9 to 15	Landolt-Börnstein Liddell
Specimen of cast iron	91	Author
Specimen of Acheson graphite	790 to 800	J. Zellner, Author
Specimen of graphized carbon (Trollhattän)	871	Author
Specimen of solid tungsten as rod	18 to 20	Landolt-Börnstein
Specimen of tungsten articles containing carbides as above (*a*)	21	Author
(*b*)	33.5	Author
(*c*)	43.9	Author

As is shown by these figures, the conductivity lies somewhere between soft iron and cast iron, which makes it suitable as a heater for high frequency inductive heating, as is also proved by experiment: A crucible having a wall thickness of only 2 mm. and 16 mm. diameter, placed in vacuum in the high frequency furnace is quickly heated to well over 1,800 deg. C.; in a magnesia crucible placed inside the tungsten heater, a clean alloy melt was thus easily obtained.

The fusion point of tungsten carbide is given in some references as about 2,700 deg. C. See Mennicke [*Metallurgie des Wolframs*, p. 21, Berlin (1911)]. The author placed a rod, prepared as above, in a wider carbon shell, having an observation opening on one side; a current of about 500 amp. was passed through the shell. The temperature of the rod was read by means of a Holborn-Kurlbaum optical pyrometer. Good readings could be taken up to 2,500 deg. C., when heavy fumes commenced to obscure the field of vision. The rod collapsed at a reading of about 2,600 deg. C.

It is probable that a sintering in hydrogen instead of in the presence of carbon apart from the carbon yielded by the glucose might give somewhat different results; as however the arrangement for heating in hydrogen at a sufficiently high temperature is much more complicated and expensive, this is not recommended. Heating in vacuo in a high-frequency furnace showed no appreciable difference.

Fig. 2 shows a series of articles produced by this method: Crucibles of various sizes, ring-shaped cylinders, intended as heaters for non-conductive containers in high frequency heating, discs for the same purpose, solid and threaded rods, etc.

If an elongated tube, say 15 or 20 cm. with thin walls, 2 or 3 mm. should be required, it is advisable to mold it with somewhat thicker walls and heat it first over a graphite rod for a short time to about 1,000 or 1,200 deg. C., at which temperature the formation of carbide is very slight and after which it may be easily ground to the desired size with an emery wheel, and then finally heated to a higher temperature. Grinding after being fully heated is more laborious, owing to the hardness of the grains. In this way, thicker gaskets may be left at the ends, to facilitate the leading in of the current, connecting clamps should of course also be made in the same manner.

History of American Explosives Industry Being Prepared

Institute of Makers of Explosives to publish comprehensive book on history and uses of principal products

A history of the explosives industry in America, the first of its kind ever prepared, will soon be published by the Institute of Makers of Explosives, of New York City. The authors are A. P. Van Gelder and Hugo Schlatter. Mr. Van Gelder is a graduate of the School of Mines of Columbia University and has been engaged in the explosives industry for 25 years, being for some time general superintendent of high explosives plants. Mr. Schlatter was at one time assistant explosives chemist of the Mine Accident Division of the Technologic Branch, U. S. Geological Survey, which later became the U. S. Bureau of Mines. He afterwards entered the smokeless powder manufacturing industry and has had a long experience in this branch of chemistry.

The new history will be a comprehensive volume of more than 1,000 pages, with about 400 illustrations. The authors have gone into their subject thoroughly. They have had the co-operation of all the explosives companies of the Institute, and have had access of records going back 124 years. The work will discuss in detail the history and use of black powder, nitroglycerin and dynamite, blasting supplies, smokeless powder, military explosives, and explosives in the making of America. This last topic will treat both in text and illustration of the uses of explosives in the mineral industry and in American engineering projects which have been built with the aid of explosives. An interesting feature of the work will be photographs of historic and important blasts.

There will be an introduction by Dr. Charles E. Munroe, Chief Explosives Chemist of the Bureau of Mines, who is recognized as one of the leading authorities of the world in his line.

The history will be published in a limited edition, and lists are now open for subscribers at the office of the Institute of Makers of Explosives, 103 Park Avenue, New York City.

Types of Building Construction For the Chemical Plant

Description of the various building methods and materials ordinarily available together with appropriate cost data

By Horton R. Parker
Technical Service Co., New York, N. Y.

THE building code recommended by The National Board of Fire Underwriters of New York gives the following classification of buildings:

1. Frame Construction.
2. Non-Fireproof Construction:
   (a) Ordinary Construction.
   (b) Mill Construction.
3. Fireproof Construction.

With the following explanation:

1. A building having the exterior walls or portions thereof of wood; also a building with wooden framework veneered with brick, stone, terra cotta, or concrete; or covered with plaster, stucco, or sheet metal shall be classed as a frame building.

2. The term "Non-Fireproof Construction" shall apply to all buildings or structures having exterior masonry walls with floors and other interior construction wholly or in part of wood.

(a) Ordinary Construction. A building having masonry walls, with floors and partitions of wooden joist and stud construction. The supporting posts and girders may be of wood or of protected metal.

(b) Mill construction (sometimes called "slow burning Construction"). A building having masonry walls, and heavy timber interior construction.

3. Building of masonry, steel, or reinforced concrete construction.....shall be considered fireproof.

This classification can be summarized into the following five general types:

1. Frame Building,
2. Wall Bearing Building,
3. Slow Burning Building,
4. Steel Building,
5. Reinforced Concrete Building,

which in turn should be judged from the standpoint of: use, size, cost, life, maintenance, insurance, alterations, environment, climate, hazards, floor loads, price of product, adjoining plants, cubical contents desired, flow chart of process, expansion, etc.

All of the above factors are controlled by the product for which the building is to be used and it is therefore of no value to discuss the advantages of one type of construction over another until something is known of the process to be carried out in the building.

Any type of building chosen may be considered as composed of the following parts:

1. Floors,
2. Walls.
3. Roof.

Each of these divisions can be constructed from different classes of material and it is evident that a wide diversity of material may be used in the same building. The intelligent and careful selection of the material used will result in an economical building in each specific case. The cost figures given are average prices for any eastern location where the unusually high prices of a metropolitan district do not prevail. It must be understood that the price will vary greatly depending upon labor conditions; size of work; time of year; location of work in relation to building material storage, etc. The figures given are, however, relative and will serve for purposes of comparison.

The choice of materials used in various types of chemical plants is immediately reflected in the maintenance cost of the building and ultimately in the general overhead charged against the product manufactured. Obviously the layout of the process will be given first consideration in the design of the building and will dictate whether a multiple or a single story building will be used. For the present neither the type of building nor the product manufactured will be considered, but attention will be given to the composite parts of the building with a discussion of their relative costs and advantages. The general viewpoint of chemical plant usage will, however, be maintained.

As a supporting structure for the building it will be necessary to have a secure foundation, by the use of concrete, rubble, masonry, or brick. In some cases the ground conditions may even make piling necessary or a combination of piling and a concrete slab. These piles may be wood, concrete, or a combination with a steel shell. One can safely figure a piling cost per lineal foot in place of $1.00 to $3.00 respectively in ground which will permit of straight and easy driving. Excavation costs for the average small foundation for machinery or building in soft dirt or clay are on the order of $3.00 a cubic yard. Wooden forms for concrete can be placed for 30c. to 35c. a square foot and concrete can be poured and finished for $12 a cubic yard. For heavier foundation these figures will average as follows: excavation $2 a cubic yard, forms 30c. a square foot, and concrete $10 a cubic yard.

An industrial flooring should be chosen with a viewpoint of combining as many of the following properties as are possible and consistent with the conditions to which the floor will be subjected:

Low initial cost
Low installation cost
Low maintenance cost
Strength
Non-corrodible
Resilient
Durable
Non-abradable
Non-slip
Noiseless
Sanitary
Waterproof
Fire resistant
Thermal insulating

Fig. 1—Common Type of Industrial Building
This building has steel frame, hollow tile walls, sheet steel or asbestos covered steel roof

The combinations obtainable in floor material are many and it will be necessary to combine some of the types in order to secure the desired properties. A brief outline with approximate costs of a few types are given. For purposes of comparison these costs have been calculated on a floor load of 200 lb. per sq.ft. except where indicated.

		Cost per Sq.Ft.
Wood	2 in. block alone	.25
	2 in. block on concrete	.60
	Planks on joists	.30
	Planks on edge	....
	Wood on concrete	.55
	Standard hardwood double floor	.55
Concrete	Cement on ground	.25
	Cement on upper floors	.50
	Checker plate 1 in	1.15
Steel	Grating	1.35
	Iron pan	....
	Tile in cement on a concrete sub-base	.70
Brick	Acid proof on concrete	.75
	Cobblestone	....
	Common	....
Dirt	Ashes	....
	Earth	....
	Lead pan	1.30
	Tin	....
Special conditions	Galvanized iron	....
	Rubber (bridges)	....
	Mastic on concrete	.65

Machine shops, textile mills, and similar plants which require the employee to stand for a considerable part of the day, are usually built with a heavy wooden floor or a wood floor on a concrete sub-base.

Chemical plants demand a floor which will stand up under extreme conditions of acid and alkali exposure. The following analysis represents the cost of laying a cinder concrete floor on the top of a building floor of wood which had a pitch of ¼ in. On top of this was placed a covering of 3-ply roofing paper upon which the bricks were laid in asphalt. A total of 992 sq.ft. of flooring was laid. The bricks were obtained at a special price.

4,800 acid proof brick	$134.30	
9.6 yards sand	19.20	
26 bags cement	18.25	
2,720 lbs. asphalt	55.76	
1 bbl. rosin	13.92	
2,023 lb. pitch	33.50	
18 rolls 3 ply roofing paper	44.10	
Total material		$319.03
Cost of labor		244.70
Total cost of job		$563.73
Material cost per square foot of floor		$0.321
Labor cost per square foot of floor		.246
Total		$0.567

The above figures are of a job installed about three years ago using yard labor at an hourly rate of 50c. Another job at the same time analyses as follows:

Material cost per square foot of floor	$0.305
Labor cost per square foot of floor	.244
Total	$0.549

For a chemical plant where leakage of acid or alkali is possible, a concrete floor is not at all desirable. There is a tendency to crack and spall around the I beams. The dilute acid runs down along the walls or pilasters and very quickly attacks and corrodes the steel. Such a construction combined with steel and concrete walls will not last over a period of five or six years. In a very short time the floors become rough and a source of high maintenance. An acid brick, laid on cement will give a smooth, permanent, and easily maintained floor at a cost very little above concrete.

For upper floors a very serviceable and reasonably priced floor can be obtained by the use of a heavy thick tile laid in asphalt or tar on a concrete sub-base. Such a floor is more quickly laid than acid brick and serves practically as well.

Common brick is used largely where heavy storage and constant trucking gives an unusually severe test to the floors.

Steel is especially adaptable to mezzanine floors and platforms because of the ease with which a strong and permanent floor can be installed. The use of a steel grating will give more light to the space below and also give a floor which will be less dangerous to the workmen because of the elimination of slippage. A heavy steel plate is sometimes laid over the wood in the aisles of storerooms to give a truck-way which will not wear out as rapidly as the wood.

Dirt floors need no consideration. They are used generally in foundries, steel fabricating shops and boiler shops.

Special conditions of use sometimes dictate an unusual type of floor covering, as for instance, a lead pan to save drips over an entire building floor. Rubber has been applied to bridges, roads and in limited cases to floors. Mastic has been used as a protection for concrete but is open to the objection that it will not stand up under heavy loads, especially when exposed to even moderate amounts of heat. The newer floor coverings of such materials as asphalt or heavy tars and pitches which have been worked up with an inert filler render excellent service for general conditions. They are cheap and can readily be applied over an old floor. Some acid proof cements have recently been placed upon the market which can be poured in place and which harden to a very serviceable floor. Their brittleness and abrasiveness under extreme conditions may, however, cause them to be eliminated in some cases.

Table of Wall Materials

Material	Type	Cost per Sq.Ft.	Curtain Walls 6-in.	Curtain Walls 8-in.	Building Walls 12-in.	Building Walls 16-in.
Common Brick	Solid air space			.75	1.20	1.60
Concrete	Block		.45	.55		
	Solid		.45	.55	.70	
Tile	Hollow		.30	.40		
Steel	Corr. iron 26g	.22				
	Asbestos covered	.27				
Wood	Shingle	.20				
	Clapboard	.20				
	Sheeting plus tar paper					
Special conditions	Gypsum 3-in	.25				
	Cement covered—1½-in.	.32				
	Glass					
	Asbestos —¼-in.	.40				

The steel or wood framework can be filled in with a number of combinations as outlined in Table 1. Concrete is probably the best material to use for walls in a building of permanent construction although both concrete and brick are nearly ideal where the size of the project warrants the investment.

Sheet metal construction of any kind has the ad-

vantages of cheap and quick erection. It will not be found of advantage in the colder climates as this type of building is hard to heat. However, for foundries and warehouses, sheet metal is very largely used since heating is unimportant and low cost is a major factor. Where corrosive conditions will not allow the use of unprotected metal, it is possible to use an asphalt and asbestos covering which will completely resist all corrosive influence.

Hollow tile offers a compromise in cost between metal and heavy masonry. The tile walls are easily, quickly and cheaply erected and are not unduly expensive to maintain. However, it should be understood that they are primarily of temporary construction and subject to rather rapid deterioration due to vibration or shock. This type of construction (Fig. 1) was very popular during the war for plants erected in the north. It has a further value in explosive plants in that it will disintegrate easily upon shock. The combination of hollow tile walls with concrete pilasters is commonly used and results in a high grade building of low initial cost.

Wooden walls are cheap, non-condensing, quickly erected and easily altered. A study of the fire hazard; corrosive action of fumes; and insurance rates, will generally be enough to show whether a wooden building is desirable for the industry under consideration. In southern climates the wood is also subject to rapid disintegration due to humidity and temperature changes.

A wooden building may be made fireproof by the use of the cement gun to coat the interior with a layer of cement. The following tabulation gives the results of a job of coating 6,000 sq.ft. with cement about 1½ in. thick:

Cement gun crew and outfit	$43.20 a day
Carpenters	.75 an hour
Laborers	.50 an hour
Cement	3.90 a bbl.
Sand	1.40 cu.yd.
Metal	.04 sq.ft.
Total time	45 hours
3 coats applied	
Square feet covered per hour	135

	Material	Labor	
Rental of outfit	.....	$432.00	
Applying lath	.....	476.00	
Applying cement	.....	318.00	
Cement—85 bbls.	$331.00		
Sand—40 yards	56.00		
Miscellaneous material and power	80.00		
Metal lath	240.00		
Total	$707.00	$1,226.00	$1,933.00
Unit Costs	**Material**	**Labor**	**Total**
Metal lath	$0.040	$0.080	$0.120
Cement	.076	.125	.201
Total cost per sq.ft	$0.116	$0.205	$0.321

There is probably no more noticeable change in building design during the past ten years than the present tendency to install as much glass as possible in the walls and roof of the buildings. The typical factory building of twenty to thirty years ago was constructed of heavy brick walls with large wooden sash windows placed between brick piers as wide or wider than the windows which resulted in a glass area of less than 50 per cent of the total wall surface. The average building of today has 85 per cent and even 100 per cent of the space between the work table and the ceiling of glass. Such a construction (Fig. 2) is cheaper than the old-fashioned heavy construction; allows the use of wider buildings and the consequent placing of machinery to better advantage; improves working conditions and results in more satisfied help. A possible disadvantage is the additional cost of heating such a building.

The roof in the average chemical plant should primarily resist corroding fumes as much as possible and next should be non-condensing or as nearly so as possible. The problem is again the choice of a suitable material to meet the manufacturing conditions. A roof for a building in which an explosive process is carried out should be light and capable of disintegrating upon shock.

The problem may be to resist heat, to give maximum light, exclude the weather, prevent condensation, furnish ventilation, fire protection, or to combine any or all of the above in as strong and well appearing a roof as possible. Appearances, however, rarely enter into a factory design. The steel roofs of the train sheds in our larger cities are a good example of a roof which combines strength and lightness with an unusually good appearance.

The following table gives the various roofing materials which are commonly used with the corresponding cost of each and the approximate thermal conductivity of the principal types. The conductivity values can be considered as relative only, as they were obtained from a number of unrelated trade sources:

	Cost per Sq.Ft.	B.T.U. per Sq.Ft.
Wood shingle	$0.10	.....
Plank with tar and gravel specification	.20	0.28
Corrugated iron	.20	1.13
Tin on plank	.25	.....
Copper on plank	.60	.....
Lead on plank—4 lb.	.80	.....
Zinc on plank	.40	.....
Slate	.40	1.14
Tile	.40	.34
Asbestos	.35	.12
Concrete, tar and gravel	.30	.50
Gypsum-Precast Tile plus tar roofing paper	.30	.18
Glass	1.25	.60

The thermal conductivity of a roof cannot be too closely studied. A roof which is subject to excessive condensation will deteriorate rapidly and raise the maintenance cost of the steel work, such a roof will also radiate heat very rapidly and be more expensive to heat during cold weather. The safety and comfort of the workman also demand a dry roof. In some cases condensation may be detrimental to the product manufactured. The same effect of excessive condensation will also be obtained by the use of thin roofs of practically any material.

In the 1925-26 Guide of the American Society of Heating & Ventilating Engineers, the following table is given for heat transmission of roofs. The values are in B.t.u. per degree Fahrenheit per square foot per inch of thickness in a 15-mile-per-hour wind:

1 in. wood, 5 ply paper, tar and gravel	0.30
1 in. wood, felt roofing	.36
1½ in. wood, 5 ply paper, tar and grave'	.26
2 in. wood, 5 ply paper, tar and gravel	.21
2½ in. wood, 5 ply paper, tar and gravel	.18
Tin on wood strips	1.60
Tin on sheathing	.60
Tin on sheathing with paper	.43
Shingles on wood strips	.87
Shingles on sheathing	.43
Shingles on paper, sheathing, strips	.21
4 in. hollow tile, paper, tar, gravel	.30
6 in. hollow tile, paper, tar, gravel	.27
2 in. concrete, paper, tar, gravel	.71
3 in. concrete, paper, tar, gravel	.64
4 in. concrete, paper, tar, gravel	.57
Flat tile on wood strips	1.07
Slate on wood strips	1.10
Slate on paper and sheathing	.50
Corrugated iron on strips	1.50
Corrugated iron, sheathing	.64

Wood, shingles, or the various tar and gravel specification roofs are easy to erect, cheap and of reasonably long life. In some cases the excessive fumes may cause a rapid disintegration in the woodwork. In such cases

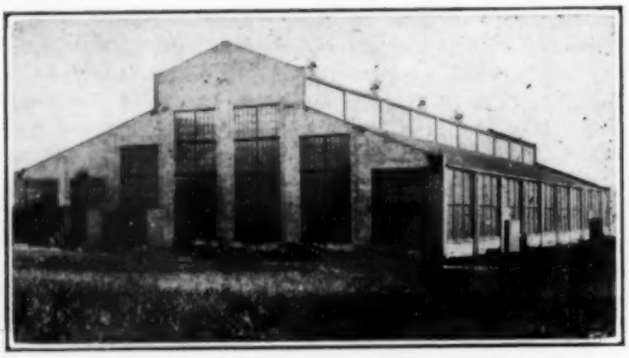


Fig. 2—More Elaborate Type of Industrial Building

Steel frame, brick walls and large glass area give a splendid structure for many purposes

a more resistant roof should be installed. Otherwise, however, a wood and tar roof is probably better for factory purposes than concrete or steel as its conductivity is lower, thus improving working conditions and lowering the heating costs.

Slate is non-corrosive, quickly laid and unusually durable. It is, however, somewhat expensive for factories and is also subject to heavy condensation. The same objections can be applied to a tile roof. Scaffolding is necessary for installation and repairs are hard to make.

Tin, copper, lead, zinc are good roofs and long lived. They are, however, expensive and subject to corrosion in specific cases and are, therefore, not generally applicable to chemical plants.

Concrete—either in the monolithic form or as precast slabs—makes an unusually good roof. It is not as subject to corrosion as the other types and is fireproof. The objections of higher installation cost, excessive condensation, greater weight per unit of thickness, may be enough to swing the decision in favor of some of the other types.

Corrugated iron is especially suited for buildings of a temporary character but has nothing to recommend it for permanency. An improvement results when the corrugated iron is covered with a heavy tar paint and in some cases tar and asbestos. Such a roof is cheap, lasting, easily erected, more resistant—and largely self-supporting. Only a light steel framework is required which results in a very cheap and efficient roof.

An unusually durable and fireproof roof is obtained by the use of an asbestos and concrete corrugated board which can be installed with the ease and cheapness of sheet iron. Such a roof does not need paint, will not rot, and is practically permanent. This material can also be obtained in the form of flat shingles which can be placed over the old shingle roof. Thus an actual advantage is obtained by securing a roof which is thicker than usual, a better insulator, and therefore non-condensing.

Gypsum roofs are much lighter in weight per unit thickness than any other material, are fireproof, easy to install and the most noncondensing roof obtainable. Such a roof can be obtained in pre-cast slabs or laid as a monolithic roof. Chemically, gypsum is more inert than most roofing material and is therefore very suitable for chemical plant construction. Such a roof is also an excellent light reflector and makes a better appearing interior than most other roofs.

No effort has been made to select any particular type of building or material of construction. Both points are so closely connected with the process that it is impossible to state that one type or material is better than another. Let us, however, consider one combination of the various materials and building types which would be economical in the average multiple story building to be used as a chemical plant.

Both for permanency and maintenance the framework should be of steel, built of heavy H section columns and heavy floor beams to allow a reasonable floor span. Floors should not be brought closer than 6 in. from all steel columns and should have a substantial curb around the opening, especially if subject to spills of corrosive liquors. Pockets in steel framing should be eliminated as much as possible.

By the use of a steel framework, it will be possible to use light curtain walls of brick or hollow tile supported by the framework. As much sash as possible should be installed unless the process absolutely does not demand light. In addition to giving light, the sash will furnish the best possible ventilation system and should be installed with this point in mind. The use of wood or steel sash is a question to be decided after a study of the corrosive action of the fumes which may arise from the process.

Brick or tile walls have been considered as preferable to a reinforced concrete building because of the corrosive action of acids and oils on concrete. The question of permanently acid proofing concrete has not yet been satisfactorily solved for chemical plant building construction.

Floors materials will require a careful study. For the ground floor an acid proof brick on a concrete subbase will satisfy the most rigorous demands. For upper floors, a tile on wood or acid proof brick or cement which is, in turn, laid on wood, will give good results.

Fig. 3—Fireproof Factory Building

This building combines decorative effect with utility at small additional cost

The use of gypsum for roofs has been growing very much lately and it seems to answer most of the requirements of a good roofing material. It is light, cheap, a good reflector, non-condensing and chemically inert.

Naturally for fire hazards a sprinkler system should be installed.

Quotations on such a building (Fig. 3) in the metro-

politan district have been made at $3.50 per sq.ft. of floor area. Obviously this figure is of little value without definite specifications. A comparison of the general uses to which the usual combination of building and material are suitable may be of interest:

STEEL FRAMING

1. Metal covering throughout (Steel Bldg.)

2. Concrete or masonry walls, floors and roof (Fireproof Bldg).

3. Masonry walls and wooden floor and roof (Wall Bearing)

WOODEN FRAMING

4. Wood throughout (Frame Building)

5. Metal walls and roof (Sheds)

6. Brick walls (Slow Burning)

1. Foundries; single story warehouses; the steel frame furnishes fire protection and also provides for a craneway.

2. Large storage buildings; general manufacturing; machine tool industries; practically any industry having no fumes or objectionable works. Multi-story, printing plant, automobiles, ideal type for permanency.

3. Drop forge shops; foundries. By putting in special types of floors this makes a suitable building for most chemical processes which require multiple story construction. Foods, sugar, etc.

4. Generally used in smaller building and in isolated plants. Drying sheds; brick yards; shelters for cheap machinery and products.

5. One story buildings—warehouses—foundries, mills, where craneways are not required. Used largely in the south wherever three or four story buildings of this type are common.

6. Chemical plants: Storehouses, mills. Probably in more general use than any other type. Examples of practically every type of industry are found in these so-called slow burning buildings.

Some Advances in Gypsum Technology

The last decade has seen marked improvements in all the steps involved in gypsum manufacture

By J. M. Porter
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THE manufacture of calcined gypsum, the base of all gypsum products excepting agricultural gypsum, may be divided into four steps:

1—Winning of the raw material,
2—Treatment of the raw material,
3—Calcination,
4—Treatment after calcination.

The source of practically all of the raw material for gypsum manufacture is gypsum rock and gypsite (an earthy form of disintegrated gypsum rock). The rock gypsum used to be quarried and the gypsite worked by teams and hand labor. At present, however, gypsum quarries are diminishing in number and mining operations are increasing. In the mining of gypsum several advances have been made, especially as to more systematic methods and improvement in the transportation facilities within the mine. Where horses and mules formerly brought the rock to the shaft a car at a time, electric locomotives handling trains of cars at each trip are now used. The hand augers of yesterday have also gone to the scrap pile and in their place will be found the modern electric or compressed air drill.

The mode of working the gypsite deposit has also changed. Instead of the gypsite being loosened and loaded into carts by hand, there will now be seen plows pulled by tractors for loosening the earth, wheeled scrapers, and in some instances steam or electric shovels loading the cars going to the mill.

After the rock has been brought from the mine or quarry to the mill the process of refining begins immediately. The rock is crushed, dried, ground, screened and calcined. In each of these steps, with the possible exception of crushing, great strides have been made.

The drying of the rock itself is quite new in the industry. This is carried out usually in a rotating cylinder which is heated by a coke fire. The introduction of this step has materially improved the ease of subsequent grinding of the rock and has lowered the cost of calcination because of the decrease in the time necessary.

In recent years the demand for uniform and more finely divided calcined material has increased. To meet this demand has necessitated several changes in the grinding of the raw rock. The old buhr mill is being displaced and in its stead is being installed the horizontal or vertical emery mill or roller mill with air separators. This latter equipment has many features in its favor, including ease of control.

Another change brought about by the same demands has been in the screening of the ground gypsum. It was formerly the practice to use the old "knocker" screen or a screen made at the mill for the complete screening process. In modern installations is found the electric vibrating screen of 30 to 40 meshes per inch, usually elevated at an angle in such a manner that the material passing through is of a fineness so that 80 to 90 per cent will pass a No. 100 sieve.

It is probable, however, that the greatest change in gypsum manufacture will be found in the process of calcination. This is true both as to methods of control and physical equipment. The "calciner" who was a highly paid and almost invaluable employee has been displaced and we find an unskilled laborer in charge of the kettles. Nevertheless, the product is more nearly uniform from kettle to kettle because the whole process is so closely controlled by means of recording thermometers, or at least by non-recording thermometers, that it is practically impossible to under or over calcine.

The kettles themselves have been improved in many respects, not the least of which is in bottom design. In the old days of cast solid bottoms it was always necessary to have a great number of extra bottoms on hand to take care of those which cracked and warped in a short time. We now find the sectional steel-pressed bottom with as many as fifteen sections and the warping and cracking previously encountered almost a thing of the past.

In an effort to obtain a more nearly uniform product much study has been given to the design of the agitators until instead of two rotating cross arms, today a very complicated and efficient stirring device is employed.

The advent of the rotary calciner has been almost

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revolutionary in the calcination of gypsum. A detailed description of this type of kiln does not appear necessary in that it is practically the same as that which has been used in the cement industry for years, consisting essentially of a revolving cylinder into which heat is led. With this type of installation the rock fed into the rotary is not ground. It is crushed so that it all passes a 3-in. ring and in this form is calcined. The rotary is fired with either powdered coal or fuel oil, is supported on trunnions and is rotated at such a speed that the rock is in the heating zone for from one to three hours. The temperature which is maintained in the product discharged varies slightly from mill to mill but is approximately 600 deg. F.

Regardless of the type of calciner employed the present-day tendency is to regrind after calcination. This is of course necessary where rotary kilns are employed but the fact that regrinding adds materially to the plasticity of the product has made it desirable in all cases. The regrinding may be done by one of several disintegrators, including buhr mills, tube mills and impact mills. If the improvement of plasticity is especially sought the tube mill is employed. These will be found in service in a number of sizes and types.

Another practice which has only recently come into general use with gypsum manufacturers is the automatic bagging machine. Previously this disagreeable work was all done by hand. By the employment of the automatic bagger a greater volume of material can be sacked in the same time without the excessive amount of dust, resulting in satisfied employees.

Results of Steaming Coke In Vertical Retorts

Determination of the changes necessary to make the yield comparable to that from horizontal retorts

IMPORTANT data on the influence of conditions, particularly steaming, upon gas and by-product yields from vertical retorts have recently been published in Technical Paper No. 15 of the Fuel Research Division, British Department of Scientific and Industrial Research, entitled "Carbonization of Coal in Continuous Vertical Retorts."

The first part of the investigation was undertaken primarily at the request of the South Metropolitan Gas Co. to ascertain whether continuous vertical retorts could produce good yields of gas and coke comparable in quality with those made in this company's horizontal retorts. For the purposes of the test a Durham coal, known as "Holmside" was selected. From this coal the company obtains gas with a calorific value of about 560 B.t.u. per cubic foot, and a coke containing not more than 3 per cent volatile.

After various experiments it was found that the following alterations to the Experiment Station setting of four Glover-West vertical retorts gave the best results:

(1) Lowering the temperature at the top of the retort, and maintaining a rising temperature gradient from top to bottom.

(2) Lowering the steam inlets from near the top of the coke chamber to just above the door casting. This caused more efficient quenching of the coke and at the same time reduced the quantity of steam actually passing up the retort. This had a marked effect in increasing the calorific value of the gas, but it was still found impossible to insure the desired calorific value, together with a low volatile content in the coke.

(3) Increasing the baffle plate between the coal inlet and the gas offtake from ten inches in length to forty inches so as to increase the length of hot brickwork to which the gas was exposed on leaving the retort. This increased the cracking of tar vapor and again raised the calorific value.

(4) Running the collecting main dry, instead of with tar circulation as usual. This again raised the calorific value of the gas by avoiding the scrubbing action of the circulating tar.

Results of Tests

As a result of (2) and (3) it was possible to use higher temperatures toward the bottom of the retort, and so increase the yield of gas, and reduce the volatile in the coke, while still maintaining the desired calorific value of the gas. The effect of these modifications is shown by the following results of three tests, each of which lasted five days and consumed 50 tons of coal.

	Short Plate Wet Main	Long Plate Wet Main	Long Plate Dry Main
Temperatures of combustion Chambers (deg. C)	1,010 to 1,240	1,090 to 1,240	1,170 to 1,235
Gas yield per ton of coal:			
Cu.ft.	11,880	11,380	11,750
Therms	65.8	64.1	66.7
Cal. value, B. Th. U.	554	563	568
Volatile matter less moisture in the coke:			
Crucible method	3.30	3.89	3.60
In nitrogen	2.14	2.50	1.88

In addition to this special investigation a set of three tests of five days each was carried out on the same coal with varying amounts of steaming. These tests were carried out under the standard conditions adopted in earlier investigations, and form the second part of the investigation. The results are strictly comparable with those of previous investigations, the results of which have been published.

The weight and thermal balances of the three tests are satisfactory, the following percentage losses being recorded:

	Weight Loss	Thermal Loss
Test 4 to 5 per cent steam	1.62	6.29
Test 5 to 12.5 per cent steam	2.75	5.82
Test 6 to 20.2 per cent steam	2.70	4.51

The general effect of steaming on the yields of products per ton of coal may be summarized as follows for increases of steam from 5 to 20 per cent:

	Steam 5.05 per Cent	Steam 20.20 per Cent
Gas: Cu.ft.	13,200	15,940
B.t.u. per cu.ft.	524	480
Therms	69.17	76.51
Tar (dry) gal.	9.58	9.52
Ammonium sulphate, lb.	18.46	21.34

The above results are normal for a medium gas coal, except that the tar yields are low and that increases with steaming are prevented by the production of high temperatures toward the top of the retorts. The yield of a ammonium sulphate, as is usual under such conditions, does not increase above 12.5 per cent steam.

The decrease in the coke yield with steaming has also been calculated per 1,000 cu.ft. of additional gas. It amounts to 12 lb. from 5 to 20 per cent steam, in comparison with 7.1 lb. with "Consett" coal which was previously studied.

Aluminum Paint - A Heat Saver

Less radiation results in higher operating temperatures with same power input

By Junius D. Edwards
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Aluminum paint performs the seeming paradox of keeping structures either hot or cold. The use of a bright metallic coat of aluminum paint on oil tanks in order to reflect the sun's rays and keep the oil cool is by now a common sight and practice. It is, however, not as commonly known that aluminum paint can be used on the outside of a furnace in order to help keep it hot. The high reflectivity of aluminum paint keeps to a minimum the absorption of solar energy by the oil tank. The low emissivity or radiating power of aluminum paint keeps to a minimum the heat lost by radiation from a furnace.

A HEATED structure, such as a furnace, loses heat in two important ways—by convection and by radiation. The convection loss is roughly proportional to the difference in temperature between the surface and the air, but the radiation loss is proportional to the fourth power of the absolute temperature of the surface. As the surface temperature increases, the radiation loss therefore rapidly assumes greater and greater importance, with a corresponding increase in the effectiveness of aluminum paint. Furnaces with rusty iron, black iron, brick, or "average" surfaces have a relatively high emissivity or radiating power, while aluminum paint, like metallic aluminum, has a very low emissivity.

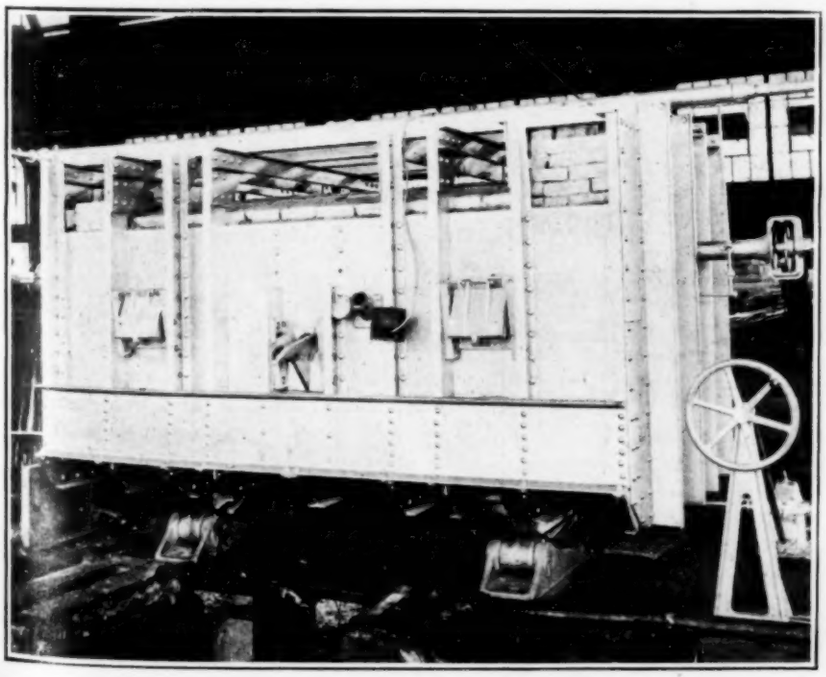
To show the effectiveness of aluminum paint, a series of tests was made upon an electric furnace of the laboratory type used for heating tubes in combustion analyses. As originally made, it was painted black with white composition-board ends. When operated in this condition, it was found by a number of observations, sufficient to determine average performance, that with a power input of about 630 watts (at 110 volts) the center of the furnace reached a temperature of 954 deg. C. (1,749 deg. F.). After applying a coat of aluminum paint to the exterior, it was found that with exactly the same power input, the temperature reached was just 22 deg. C. (40 deg. F.) higher, namely, 976 deg. C. (1,789 deg. F.). Obviously the original temperature could have been maintained with a smaller power input with the aluminum painted surface. With furnaces operating at a higher temperature, the gain would be even greater. In many cases the upward extension of the attainable furnace temperature, which can be reached by the use of aluminum paint, is particularly desirable. If a higher temperature is not necessary or desired, the operating temperature can be maintained with a smaller power input than when an ordinary brick or iron surface is employed.

Cooler Atmosphere in Furnace Room

An additional important advantage of the aluminum paint on furnaces in the plant is that it makes the neighborhood of the furnace more comfortable for the workmen, since they receive less heat by radiation. In one particular case, two identical furnaces stood about 12 feet apart. One was finished with aluminum paint and the other with black paint. Standing between and equidistant from the furnaces, one could not help but notice the greater amount of radiant heat coming from the black furnace.

Of course, the surface of the aluminum painted furnace is actually hotter than if it were not so painted, because a larger proportion of the heat must be carried away by convection; the aluminum paint dams up the heat, to use a crude analogy. In the case of the laboratory furnace previously cited, a particular point on the surface was at a temperature of 168 deg. C. (334 deg. F.) when painted black, and 224 deg. C. (435 deg. F.) when coated with aluminum paint. With a higher surface temperature, a greater amount of heat can be dissipated by convection.

It is fortunate that with such useful thermal properties, aluminum paint can be made which will adhere to heated surfaces without discoloration or serious loss



An Aluminum Painted Melting Furnace

Aluminum paint is fast becoming the standard finish for tanks in which crude petroleum, gasoline and other volatile liquids are stored. By reflecting the heat rays, the contents of the tank are kept cooler by several degrees than when a darker, heat-absorbing surface is exposed. But it is not so well-known that because of its low radiating power, aluminum paint can also be used on the outside of a furnace to help keep it hot. There is not only a considerable gain in operating temperature, but there is a cooler atmosphere around the furnace, thus making for more comfortable working conditions.

of adhesion. The paint should, however, be specially made, if the best results are always to be secured. For use on surfaces which are not to be heated over about 250 deg. C., almost any good varnish, properly thinned, can be used as a vehicle. The paint is made by mixing the vehicle with aluminum bronze powder in the proportion of two pounds of powder per gallon of vehicle. Of course, the surface should be clean, dry and cold when the paint is applied, and the paint should be allowed to dry thoroughly before it is heated, otherwise blistering might occur.

Above 300 deg. C., the ordinary oil and varnish vehicles will char and may even burn out completely. However, if they are of proper composition, the aluminum powder will remain untarnished and adherent, even when heated at temperatures as high as 500 deg. to 600 deg. C. (932 deg. to 1,112 deg. F.). There are a number of vehicles being commercially marketed for this purpose and their use is recommended because of their excellent performance. As a class, these vehicles are gloss oil varnishes, usually rather thin in consistency. It is desirable to have no more binding material in the paint film than necessary and to bring the aluminum powder into as intimate contact with the iron surface as possible. Although the aluminum powder does not actually alloy with the iron, the resinous material in the vehicle produces very good adherence between the aluminum powder and the iron. Of course, after the vehicle has burned out, the paint film is not waterproof nor weatherproof.

Aluminum paint may also be used effectively on high-pressure steam pipes and chemical equipment where its thermal properties are valuable and where an excellent protective paint is desired. While aluminum paint is not "acid proof," it has shown very good resistance towards low concentration of acid vapor. It has the particular merit of not discoloring in the presence of hydrogen sulphide, and may be used with advantage around chemical laboratories, oil refineries and plants where sulphur-containing gases are present to greater or less extent.

Cost of Steam Generation

Reports of war-time operation on six chemical plants show relation of various boiler-room expenses

In the figure and table are shown comparative costs of steam generation in 6 British chemical plants for a period of 6 months. Coal is charged uniformly at $5 per ton. At the start it should be explained that the quality and calorific value of coal used was unusually poor as can be surmised from the low evaporation obtained in several plants, notably at plant GAE. In fact, judged by usual industrial standards, the evaporation from and at 212 deg. F. is much below the average.

A wide range of output is represented, plant QY producing 41,600,000 lb. during the 6-month period as compared with plant PY with 548,000,000 lb. The effect of small plant size on steam cost is shown in plant QY, which had the highest cost per 1,000 lb. or 53.7c., but among the other plants, there appears to be no relation whatever between output and unit cost. This is logical, as coal is the largest factor in cost, and beyond a certain minimum, we should not expect any increase in boiler efficiency, except that due to special economizer equipment.

Steam Production

Comparative costs of steam per 1,000 lb. in 6 plants for a 6-month period. Coal is charged at $5 per ton. Evaporation is from and at 212 deg. F.

Plant.....	QY	PY	GANG	GANC	GAE	GAG
General.....	$0.28	$4.73	$3.15	$3.36	$0.03	$0.29
Maintenance...	12.08	3.29	4.16	9.41	0.73	7.14
Power.....	1.47	1.26	1.19	1.05	0.86	0.75
Labor.....	9.05	10.48	9.08	4.98	8.48	8.03
Coal.....	30.82	28.95	32.35	31.15	36.11	28.11
Total.....	$53.70	$48.72	$46.93	$46.95	$46.21	$44.32
Output for period, 1,000 lb....	41,600	548,000	112,000	497,500	65,250	58,200
Evaporation, lb. from and at 212 deg. F.	8.76	8.30	7.83	8.88	7.46	8.44

Differences in coal consumption are due in part to variations in calorific value of the fuel, and a strictly quantitative comparison should take this factor into account. Unquestionably, however, coal consumption could have been reduced in some plants such as GANG and CAE, to approach the low marks set by plants PY and GAG. It is not known whether or not the plants being discussed were provided with proper control devices such as draft gages, carbon dioxide recorders, coal meters, water meters and steam meters. Without these invaluable aids to efficient boiler plant operation, it is extremely difficult if not impossible to maintain good operating conditions.

The operating expenses, labor, maintenance and general expense were extremely variable, and no doubt substantial reductions could have been made, particularly in maintenance expense at plants QY, GANC and GAG, and in labor at plant PY. A total cost of 44c. per 1,000 lb. does not appear to be an unreasonable standard, and in one of the larger plants, GANC for example, the attainment of this standard would have saved $30,000 annually.

Steam Production

Comparative costs of steam per 1,000 lb. in 6 plants for a 6-month period. Coal is charged at $5 per ton.

Sodium Compounds in Commerce

Methods used in the production and sales distribution of sodium chlorate, sodium bichromate, and sodium nitrite.

By H. M. Batters
Market Editor, *Chem. & Met.*

CONSIDERED solely from the standpoint of value of products, the sodium compounds, as a group, form an important part of the domestic chemical industry. Data collected at the biennial census of manufactures revealed that sodium compounds produced in this country in 1923 had a marketable value of $114,374,028. Even greater importance attaches to the fact that these compounds are essential raw materials for manufacturers in various lines and hence hold an established place in the industrial structure of the country. In many instances the United States is so favorably situated with reference to natural resources that it holds a premier position in the manufacture of sodium compounds. In other cases domestic manufacture has been established and maintained only after overcoming the keenest kind of competition from foreign producers. Sodium nitrite was the first of the chemicals to invoke the aid of the flexible provisions of the present Tariff act as a means of equalizing lower production costs abroad.

MARKETING

Differing from one another in methods of production and in industrial uses, sodium bichromate, sodium chlorate, and sodium nitrite show a similarity with respect to the small number of producers who have survived the competitive periods which mark the history of these chemicals. Changes in processes, in supplies of raw materials, and in import duties have been problems met in the marketing of these compounds.

CHEMICAL PRODUCTS

Sodium Bichromate

Sodium bichromate, the most important of the chromium salts, corresponds to the formula $Na_2Cr_2O_7 2H_2O$. It is, therefore, a sodium salt of chromic acid and contains, by weight, slightly more than 67 per cent of the acid. Sodium bichromate crystallizes in anhydrous thin prisms of a fine red color. The crystals are very deliquescent and are readily soluable in water.

Chromite or iron chrome ore is the basic material from which sodium bichromate is obtained. This ore is pulverized to 100 to 200 mesh and mixed with soda ash to which limestone generally is added. The mixture is heated in an oxidizing atmosphere, the resultant mass containing sodium chromate, calcium chromate, soda ash, and iron oxide. After lixiviation with water the excess soda ash and calcium chromate form sodium chromate and calcium carbonate. The latter is precipiated and leaves a solution of sodium chromate. After foreign matter has been removed the solution is evaporated and sulphuric acid is added to convert the chromate into bichromate which is crystallized out of solution.

Production of sodium bichromate in this country began in 1846. During the war years there were seven different producing companies, one of whom was located near the Pacific coast. At present the only producing companies are the Mutual Chemical Co. with plants at Baltimore, Md., and Jersey City, N. J.; the Natural Products Refining Co., Jersey City, N. J.; and the Martin Dennis Co., Newark, N. J. As the majority of domestic tanning and textile plants are adjacent to the Atlantic coast it follows that the largest outlet for sodium bichromate is in that section. This accounts for the location of present producing plants, although another reason may be found in the fact that chrome ore, which is an important raw material in the manufacture of sodium bichromate, comes from foreign countries and the cost of long railroad hauls is thus eliminated. There is also a large consumption of sodium bichromate in the middle west and the largest individual buyer of this chemical is located at Milwaukee, Wis.

Official figures relative to domestic production of sodium bichromate for the last two years are not available, the latest data referring to 1923, for which year the output was placed at 26,879 short tons including chromate and bichromate. Private estimates give 1925 production as about 29,000 tons of which about 26,000 tons is estimated as bichromate. Production as given by the Bureau of the Census is given in Table I.

Table I—Census Data on Sodium Bichromate Production

	1923	1921	1919
No. of establishments	5	9	5
Total production, tons	26,879	18,169	24,081
For sale, tons	26,879	18,169	22,992
Value	$3,994,566	$3,823,465	$5,337,389

Domestic consumption of sodium bichromate is estimated at about 22,000 tons per year. In the last twelve years consumption has more than doubled. This increase is due partly to enlarged operations in the principal consuming industries and partly to the substitution of sodium bichromate for potassium bichromate. As sodium bichromate does not come into competition with other raw materials, the volume of consumption is not influenced by price fluctuations but is dependent on activities within the consuming trades.

Sodium bichromate finds its largest outlet in the leather trade where the chrome-tanning process is used. This process, which was developed commercially in 1884, forms an important branch of the leather industry and is used in the manufacture of glazed kid, glove leather, calf and kid upper leather, and cattle-side upper leather. It is estimated that 45 per cent of total domestic production goes to the leather trade, 20 per cent into dying and printing textiles, 15 per cent into the manufacture of chrome colors and pigments, 15 per cent is exported, and 5 per cent goes into miscellaneous uses, including

pickling of brass, electroengraving of copper plates, and laboratory work. Export trade and consumption in the leather and color trades are increasing while the quantities going to the textile trade are decreasing. The present distribution of sodium bichromate is estimated in Table II.

Table II—Consumption of Sodium Bichromate by Industries

	Tons	Per Cent of Total Production
Tanning of leather	11,700	45
Dyeing and printing textiles	5,200	20
Chrome colors and pigments	3,900	15
Exports	3,900	15
Miscellaneous	1,300	5
	26,000	100

Large consumers usually cover annual requirements for sodium bichromate by placing contract orders providing for regular monthly deliveries over the contract period. The heaviest contracting season is in the late summer or early fall months. Most of this business is placed direct with producers who establish quotations on a sliding scale depending on the quantities involved. Contract prices to the dealer trade usually command a premium over those named to consumers. For delivery in the New York district and in other points not far removed from producing points, sellers frequently quote on a basis delivered consumers plant. In other cases the quotation is f.o.b. producers works, although it is not unusual for sellers to equalize freight rates so as to hold their delivered prices within competitive limits. As consumption of sodium bichromate continues throughout the year, there is a more or less regular business in the spot market in which producers, dealers, and brokers participate. Ordinarily prices asked for spot goods are fractionally higher than those quoted on contracts.

Sodium bichromate is packed in casks weighing 675 lb. gross, 600 lb. net with a displacement of 14 cu.ft. The products now on the market have been so standardized that buyers place no stress on specifications. Sellers, however, guarantee their product to be 98½ to 99 per cent pure with content of 66½ per cent chromic acid, 12 per cent water, ½ per cent sodium sulphate, 1 per cent insoluble matter.

The principal raw materials used in making sodium bichromate are chromite—chrome iron ore—soda ash, sulphuric acid, and limestone. All these materials are offered freely by domestic producers with the exception of chrome ore. Deposits of chrome ore are found in this country but they run lower in chromic acid content than foreign ores and on that account the latter are given the preference. During the war when it was difficult to secure tonnage to move foreign chrome ore, recourse was had to domestic ore which usually was concentrated to increase the chromic acid content. In 1918 shipments of domestic chrome ore reached the record total of 82,430 long tons, whereas production each year since 1920 has been less than 500 tons and in 1925 shipments from mines were only 108 tons with total production 157 tons. Shipments of chrome ore from domestic mines have varied as set forth in Table III.

Table III—Chrome Ore Shipped from Domestic Mines

	Long Tons	Value		Long Tons	Value
1916	47,035	$726,243	1921	282	$2,900
1917	43,725	1,049,400	1922	355	7,288
1918	82,430	3,955,567	1923	227	3,819
1919	5,079	129,302	1924	288	1,140
1920	2,502	44,857	1925	108	2,105

It is estimated that 20 per cent of the chrome ore now imported goes into the manufacture of chromium salts, the steel and refractory industries having increased their requirements. Importations for the last ten years are shown in Table IV.

Table IV—Chrome Ore Imported into the United States

	Long Tons	Value		Long Tons	Value
1916	115,945	$1,548,402	1921	81,836	$654,602
1917	72,063	1,110,659	1922	90,081	741,186
1918	100,142	2,892,825	1923	129,693	1,123,120
1919	61,404	1,381,497	1924	118,343	1,095,603
1920	150,275	1,921,824	1925	149,739	207,420

Imports for the first six months of 1926 were 88,999 tons valued at $709,073.

Prices for sodium bichromate before the war ranged from 4½c. to 5c. per lb. During the war the cost of raw materials increased sharply and importations of the basic material, chrome ore, were restricted, with the result that values rose steadily. Demand for sodium bichromate, in that period, also increased so as to outstrip supply. This condition was sufficient to bring about a rapid rise in values, but the situation was further complicated by the introduction of speculative buying and in 1916 sales of sodium bichromate were reported as high as 70c. per lb. In 1917 and 1918 market values for sodium bichromate eased off, although still holding far above normal levels. In 1919, following the cessation of hostilities, there was a rapid fall in values with a temporary recovery in 1920 as consuming demand became active. From 1921 to date asking prices were on a relatively low level. Competitive selling has been prominent in recent years and the proximity of producing costs and sales prices has lessened the number of producers. The range of prices for sodium bichromate for 1914-1925 is indicated in Table V.

Table V—Spot Prices for Sodium Bichromate, New York Market

	Cents per Lb.		Cents per Lb.
1914	4½– 5	1920	33 – 9½
1915	4½–20	1921	7½– 8½
1916	20 –70	1922	6½– 7½
1917	15½–26½	1923	7½– 8½
1918	16½–30	1924	6 – 7½
1919	7½–18	1925	6 – 6½

In the present year, prices have ranged from 6¼c. to 6¾c. per lb. with some sales for export made at less than 6c. per lb.

In 1910, 2,418,742 lb. of sodium bichromate valued at $92,066 was imported into this country but since that year imports have been negligible. Export statistics are not available for the years preceding 1925, but in that year shipments to foreign countries amounted to 7,299,336 lb., valued at $444,630. In the first six months of 1926, exports were 4,017,429 lb., valued at $244,304.

An import duty of 3c. per lb. was placed on sodium bichromate in 1890. The specific duty was changed in 1894 so as to make importations dutiable at a rate of 25 per cent ad valorem. A specific duty of 2c. per lb. was made effective by the Tariff Act of 1897, which was reduced to 1¾c. per lb. in 1909 and was further reduced to ¾c. per lb. in 1913. The present Tariff Act makes sodium bichromate dutiable at the rate of 1¾c. per lb.

Sodium Chlorate

Sodium chlorate appears on the market in the form of colorless crystals. It has the chemical formula $NaClO_3$ and thus contains, by weight, 21.6 per cent sodium, 33.3 per cent chlorine, and 45.1 per cent oxygen. It is highly soluble in water which gives it the preference with certain consumers when it is brought into competition with potassium chlorate.

Sodium chlorate can be produced by saturating milk of lime with chlorine gas to produce calcium chlorate which may be converted into sodium chlorate by treatment with sodium sulphate. This process, however,

has not been used commercially for several years and present manufacture is confined to the electrolytic process. The latter process embodies steps which are secrets of respective manufacturers. In general, the process provides for the passing of an electric current through a solution of sodium chloride—common salt. The electrolysis results in the decomposition of the sodium chloride into sodium hydroxide and chlorine which combine to form sodium chlorate with an excess of sodium chloride. The latter is precipitated out and the sodium chlorate solution is evaporated and crystallized.

As sodium chloride, the basic raw material necessary for the manufacture of sodium chlorate, is found in this country in large supply, it is evident that domestic production of sodium chlorate is not restricted from that standpoint. The cost of electric power is a big factor in production costs and has much to do with determining the location of plants.

Separate returns for sodium chlorate production never have been published by government bureaus nor has any definite information been issued relative to domestic consumption. Both production and consumption are said to have reached their peak in 1917 and 1918. Combined production of sodium chlorate and potassium chlorate was officially reported at 5,785 short tons valued at $904,550 in 1909 and 8,304 short tons valued at $1,131,316 in 1914. Since 1914, production figures for chlorates have not been issued. It is estimated that current production of sodium chlorate approximates 3,000 tons per year.

Because of its availability as an oxidizing agent, sodium chlorate finds a good outlet in the dyeing and printing of textiles and in the manufacture of coal-tar dyes. It also is used in the production of explosives, and in the pharmaceutical trade. During the past year,

Table I—Imports of Sodium Chlorate, 1918-1923

	Lb.	Value	Average Value per Pound
1918	44,810	$8,066	$0.17
1919	39,022	3,814	.0977
1920	561,513	50,266	.0895
1921	659,342	33,456	.0508
1922	1,367,812	58,348	.0427
1923	1,333,418	49,352	.0370

sales of round lots were reported for use as weed killers. The latter use gives promise of increasing not because of greater efficiency of the chlorate compound but through a desire on the part of users to eliminate cattle poisoning by decreasing the use of arsenicals.

Imports of sodium chlorate did not assume large proportions until 1920, but from that year foreign chlorate has reached this country in relatively large volume. Competition from imported chlorate has had a marked influence on values. Import statistics are not given in the ordinary government returns but figures are available as shown in Table I.

Exports of sodium chlorate also are not separately reported but are said to represent only a small percentage of domestic production, although in 1917 the greater part of one manufacturer's output was shipped out of the country.

Sodium chlorate is sold in kegs, weighing 125 lb. gross, 112 lb. net, and having a displacement of 3.8 cu.ft. A sales company representing manufacturers handles the entire domestic output. Prices are quoted on basis f.o.b. producers works, and spot New York.

The price history of sodium chlorate shows that wartime influences had an appreciating effect on values with the record price of 35c. per lb. reached in 1916 and 1917. Despite the general increase in manufacturing costs, it is noted that recent quotations for sodium chlorate have been below the average levels maintained in pre-war years. Price fluctuations for sodium chlorate will be found in Table II.

Table II—Market Prices for Sodium Chlorate

(Cents per Lb.)

1914	7½–14	1920	10 –11
1915	14 –25	1921	6½–10
1916	25 –35	1922	5 – 7
1917	23 –35	1923	6½– 6¾
1918	18 –27	1924	6½– 6¾
1919	10 –20	1925	6½– 6¾

In reviewing prices during the War years, a distinction must be drawn between the open market quotations, which were largely on the part of second hands, and the sales prices of producers to consumers. The latter were considerably lower and did not pass the 20c. per lb. level at any time.

Sodium Nitrite

While sodium nitrite has been produced in this country for many years, domestic production practically dates from the development of the dye industry during the war years. At present three companies are manufacturing this chemical—American Nitrogen Products Co., Seattle, Wash., The Semet-Solvay Co., Syracuse, N. Y., and the Harshaw, Fuller & Goodwin Co., Cleveland, Ohio.

Commercial sodium nitrite corresponding to the formula $NaNO_2$ takes the form of small crystals which have a slight yellow tint, although the pure dry salt is colorless. It contains about 86 to 98 per cent sodium nitrite and is readily soluble in water.

There is a natural sodium nitrite found in sodium nitrate deposits in Chile, but this never has assumed commercial importance. Three processes have been developed for the manufacture of sodium nitrite and all three are employed in this country. The arc process utilizes atmospheric nitrogen and converts it by an electric arc into nitrous and nitric oxides which are absorbed in a solution of soda ash to form sodium nitrite. This process is used by the American Nitrogen Products Co. The ammonia-oxidation process is based on the transformation of ammonia into oxides of nitrogen by passing it over a heated platinum catalyst. The oxides are converted into sodium nitrite through the same procedure as described in the arc process. This ammonia oxidation process is followed by the Semet-Solvay Co. The sodium-nitrate process is merely the reducing of sodium nitrate. Usually lead, free from antimony and zinc, is used as the reducing agent. The lead is added to molten sodium nitrate and the resultant liquid contains upward of 90 per cent sodium nitrite, which is evaporated and crystallized. The lead is recovered in the form of litharge. The Harshaw, Fuller & Goodwin Co. use this process. Prior to the war this was the only process used in the manufacture of sodium nitrite in this country. There is practically no difference in the quality of sodium nitrite produced by these different processes.

The principal producing countries outside the United States are Norway and Germany. The only large producer in Norway is the Norsk Hydro-Elektrisk Kvaelstofaktieselskab of Christiania, with plants in Rjukan and Notodden. This company uses the arc process and is said to have an annual capacity of about 24,000,000 lb. of nitrite. In Germany sodium nitrite production centers in the Badische Anilin und Soda Fabrik where the ammonia-oxidation process is em-

ployed. Productive capacity is said to be large, although no definite figures are available.

The principal raw materials required for the manufacture of sodium nitrite, depending on the process used, are soda ash, ammonia, lead, nitric acid, and sodium nitrate. With the exception of the last named, all of these materials are readily available from domestic sources. For operation under the arc process the availability of hydroelectric or other cheap electric power is an important factor.

Domestic production of sodium nitrite was small up to 1917, but from that year began to assume greater importance. Steady progress, however, was difficult because of the competition offered by imported nitrite and the output of domestic manufacturers in recent years has varied largely in proportion to the degree of foreign competition. In 1921 domestic plants were closed for several months owing to the controlling position of foreign-made nitrite and operations were resumed only when assistance in the form of higher import duty had been assured. In 1925 the home output was estimated at approximately 5,000,000 lb. which represented a decided increase over that for preceding years. Production of sodium nitrite was reported by the U. S. Geological Survey from 1917 to 1920 inclusive, but this was discontinued after the latter year. The census figures also do not report separately on sodium nitrite production so no official figures for more recent years are available. The Geological Survey figures are given in Table I.

TABLE I—DOMESTIC PRODUCTION OF SODIUM NITRITE

	Lb.	Value	Average Value Cents per Lb.
1917	1,722,000	$480,145	27.85
1918	3,402,000	609,779	17.90
1919	2,364,000	265,121	11.21
1920	2,394,000	405,184	16.92

Normal consumptive requirements of this country have increased in recent years and it is estimated that approximately 7,000,000 lb. of sodium nitrite is needed to satisfy annual needs. Domestic plants, if run at capacity, would be able to take care of the greater part of these requirements, but imported nitrite still finds a good market. The largest outlet for sodium nitrite is found in the dye trade, especially among manufacturers of azo dyes with whom it is an indispensable raw material. In the textile trade it is used as a diazotizing agent and also as a bleaching agent. It has had a restricted use in meat pickling but a recent government decree may extend this use. Miscellaneous uses also are found in the photographic and pharmaceutical industries and in laboratory work.

As the greater part of dye production in the United States is adjacent to the Atlantic coast, it follows that the largest market for sodium nitrite is found in the same section. Large consumers are accustomed to place contracts covering seasonal or annual requirements, and this business generally is directly between manufacturer and consumer. Usually contract prices are quoted on a basis of delivery at consumer's plant, but sometimes are on a basis f.o.b. producing point, in which case freight rates are of importance. Sales also are made, either by producers or by dealers and brokers, for immediate delivery and this may involve shipment from works or from warehouse stocks held at distribution points. Domestic nitrite is packed in barrels containing 500 lb. Imported nitrite is distributed in casks weighing 650 lb. and in barrels of 450 lb. each.

Export trade in sodium nitrite never has reached an appreciable figure, but imports have ranged in quantities from less than 200,000 lb. to more than 11,000,000 lb. per year. The highest total was reached in 1920 when 11,690,142 lb. was brought into this country. Norway and Germany are the chief contributing countries. Table II shows the import statistics.

TABLE II—DOMESTIC IMPORTS OF SODIUM NITRITE

Fiscal Year	Lb.	Value	Average Value Cents per Lb.
1908	199,857	$10,015	5.06
1909	152,393	7,258	4.76
1910	1,132,778	52,237	4.61
1911	477,707	21,205	4.44
1912	974,667	47,399	4.86
1913	1,269,544	57,595	4.53
1914	1,844,379	76,813	4.26
1915	1,696,567	74,267	4.38
1916	2,593,330	170,160	6.56
1917	3,675,179	261,655	7.12
1918	2,755,033	248,294	9.01
Calendar Year			
1919	2,550,689	246,729	9.67
1920	11,690,142	1,376,992	11.79
1921	3,174,642	238,083	7.49
1922	1,461,528	58,302	3.98
1923	4,685,501	209,026	4.46
1924	4,578,091	180,816	3.95
1925	1,971,105	78,149	3.96
1926	*1,649,527	60,011	3.64

* Six months ended June 30.

In former years Norway held the leading position as a shipper of sodium nitrite to this country, but in 1924 after the import duty had been advanced shipments from Norway declined in volume and Germany is now the largest foreign source of supply. In the first six months of 1926 imports from Germany reached a total of 1,020,477 lb. valued at $37,312 or an average value of 3.65 cents per lb. as compared with arrivals from Norway of 628,050 lb. valued at $22,669, or an average value of 3.60 cents per lb. Imports of 1,000 lb. valued at $30 were reported in June, the shipments having come from Canada.

Market prices for sodium nitrite in pre-war years range from 6c. to 7c. per lb. They rose sharply as the domestic dye industry was developed. After the war values took a downward course and early in 1921 selling competition brought quotations down to the pre-war level. Spot quotations in the New York market are shown in Table III.

TABLE III—SPOT PRICES FOR SODIUM NITRITE

(Cents per Lb.)

1915	6½–21	1921	6 –10
1916	18 –21	1922	6 –10
1917	18 –22	1923	7½–10
1918	32 –44	1924	7½– 9½
1919	11 –21	1925	8½– 9
1920	12 –30	1926	8½– 9

In 1909 an import duty of 2c. per lb. was levied on imports of sodium nitrite. This remained in force until 1913 when the duty was reduced to ½c. per lb. From May 28, 1921, to Sept. 21, 1922, imports were under license control. The Tariff Act of 1922 increased the rate of duty to 3c. per lb. In October, 1922, an application was filed with the U. S. Tarriff Commission requesting an increase of 50 per cent in the import duty under the flexible provisions of the existing Tariff act. This request resulted in an investigation by the Commission and on May 6, 1924, the President issued a proclamation whereby the duty was set at 4½c. per lb.

Some domestic manufacturers in the late spring months offered sodium nitrite for June forward deliveries at 8½c. per lb. f.o.b. producers' works. This quotation has remained in force up to the present and holds good both for prompt shipment and for contract business.

EDITOR'S NOTE: *Marketing of other sodium compounds will be discussed in a subsequent issue.*

On the Engineer's Book Shelf

Kinetics of Chemical Change in Gaseous Systems

THE KINETICS OF CHEMICAL CHANGE IN GASEOUS SYSTEMS. By *C. N. Hinshelwood*. Oxford University Press, American Branch, New York. 204 pp. Price $4.25.

Reviewed by Hugh S. Taylor

This book should be read by all chemists and chemical engineers who wish to know what is known concerning the mechanism of chemical reactions. The author has chosen gaseous reactions because the kinetic theory of gases and the gas laws permit a more thorough interpretation of the behavior of reacting molecules. The whole field of inquiry is reviewed, homogenious gas reactions and those occurring at the surface of containing vessel or catalyst, the order of reactions, the possible modes of activation and the importance of these comparatively. The presentation is logical, thorough and so clear that one is tempted to think the subject is in reality very simple. However, the author continually emphasizes how much is really known and what problems await solution. In a period of industrial development which is more than anything else characterized by the application of physical chemistry and catalysis to the solution of industrial chemical problems, a prominent place for this book should be found on the library shelves of every industrial research organization. The book will refresh its readers and review for them their fundamentals in the field of reaction speed.

Analysis of Iron and Manganese Ores

METHODS OF THE CHEMISTS OF THE UNITED STATES STEEL CORPORATION FOR THE SAMPLING AND ANALYSIS OF IRON AND MANGANESE ORES. Published by the Carnegie Steel Company, Pittsburgh, Pa. 148 pp. Price $2.00.

Reviewed by Robert S. Williams

The necessity of a third edition indicates the demand for this little book and the names of the co-operating authors is a guarantee of the reliability of the methods included. Slightly more than one-third of the book is devoted to a detailed discussion of the extremely important and frequently neglected question of sampling. As the book is essentially a set of instructions for chemists doing analysis of iron and manganese ores its arrangement is necessarily an arbitrary one. The methods are in four groups: (I) Ordinary Iron Ores; (a) routine method for classifying and grading ordinary ores, (b) complete analysis of ordinary iron ores; (II) Iron Ores Containing Lead, Barium and Copper; (III) Iron Ores Containing Chromium and Nickel; (IV) Manganese Ores.—The methods are in principle the familiar ones but are modified in many instances to meet the special needs. The reviewer wishes that when several methods are given for the same element that the authors had felt it wise to consider briefly the advantages and difficulties of each. The question of precision in calculation is often overlooked as, for example, when the suggestion is made to take an ore sample weighing 3.5 grams and later to use a calculation factor of 0.142397. In spite of a few minor faults of this kind the book is so clearly written and the methods so carefully selected that it should be of very great value to the chemist who is chiefly concerned with ore analysis and of interest and use to the general analyst.

Physical Chemistry for Colleges

PHYSICAL CHEMISTRY FOR COLLEGES. Second Edition. By *E. B. Millard*, associate professor of physical chemistry, Massachusetts Institute of Technology. McGraw-Hill Book Company, Inc., New York. 458 pp. Price $3.50.

Recent progress in physical chemical science has been so rapid, particularly in the fields of X-rays and crystal structure and the chemistry of solutions, that appropriate revision and enlargement of parts of "Physical Chemistry for Colleges" has been made. This book, which first appeared in 1921 comes from one of the most virile schools of physical chemistry, and its wide acceptance has been well deserved.

The Chemistry of Rubber Manufacture

THE CHEMISTRY OF RUBBER MANUFACTURE. By *Lothar E. Weber*. J. B. Lippincott Co., Philadelphia. 372 pp. Price $9.

Reviewed by John M. Bierer

The appearance of a new textbook on any subject, whether it be thermodynamics or rubber, is justified only if it brings the subject more up to date, if it describes and explains established facts in a different and better way or if it is written in an imaginative vein and is rich in suggestions of future research. At least in the first two of these desiderata, "The Chemistry of Rubber Manufacture" by L. E. Weber, fulfills the requirements of a new text or reference book.

To those familiar with the classic book of his father, C. O. Weber, the new publication of the younger Weber appears at first to be a revision of the earlier work. But closer examination makes one agree with the author that it is "essentially a new work" necessitated by the fact that the rubber industry has undergone profound changes. Subjects like the plantation industry, reclaimed rubber, the synthesis of rubber and organic accelerators, which were unknown or of little significance when the older book was written, have become of vast importance and had perforce to be described in detail in the new book.

It is also obvious that rubber chemistry and technology have grown to a point where detailed treatment of all the aspects would require several volumes. All that could be hoped for within the compass of a single volume was a well chosen and general manner of treatment of the individual topics. Dr. Weber has accomplished this in a very clear and readily understood style.

In thus confining his treatment to a more or less general survey of the various topics, his task was rendered easier by the gift of a clear and logical manner of presenting facts. It is doubtful whether any previous

publication dealing with rubber has been written in as clear and simple a style and yet at the same time more scholarly and highly informative.

The book should be of interest both to the scientist and to the practical man, as it gives a clear conception of our present-day knowledge of the chemistry of rubber. Efforts have been made to present both sides of disputed questions, and the treatment is popular enough for those unfamiliar with rubber chemistry to appreciate better its problems and for those already familiar with the subject to review their knowledge and awaken their imagination of future problems.

A Manual of Radioactivity

A MANUAL OF RADIOACTIVITY. By *George Hevesy*, Copenhagen and *Fritz Paneth*, Berlin; translated by *Robert W. Lawson*. Oxford University Press, American Branch, New York. 252 pp. Price $5.

The original German edition of "A Manual of Radioactivity" was prepared in 1923, primarily as an inclusive but easily read book for the advanced student and research worker. Dr. Lawson's translation has included considerable revision, and developments in the first part of 1925 are embodied. As a preliminary to specialized study on any phase of radioactivity, this book is recommended.

General Chemistry

GENERAL CHEMISTRY (Second Edition). By *Hamilton P. Cady*, professor of chemistry in the University of Kansas. McGraw-Hill Book Company, Inc., New York. 540 pp. Price $3.25.

The second edition of Cady's book has been justified by the substantial progress of chemical science since 1916, the date of the first edition. As in the previous edition, readers will find a remarkably logical and simple treatment of chemical theory, an excellent basis for advanced college courses in physical and inorganic chemistry. The book does not aim to hold the student's interest through pictures and extended descriptions of industrial processes. Rather the tone of the work is a serious one, with emphasis on fundamentals, a knowledge of which cannot be gained too early in professional courses in chemistry and chemical engineering.

Laundry Chemistry

LAUNDRY CHEMISTRY. A Short Handbook on the Chemistry of Laundry Materials and Methods. By *A. Harvey*, analytical and consulting chemist. Crosby Lockwood and Son, London. 116 pp. Price 4s.

The appearance of a book, even though it be a small one, on laundry chemistry is a good indication of progress in this important industry. In this country laundries have awakened to the possibilities of technical counsel and control, particularly with respect to steam generation, corrosion prevention and water softening. But hardly a start has been made. Integral technical service, rather than consulting service only, must come. Harvey's book should be a real practical help to laundry chemists. It is plainly written, sound and is sufficiently inclusive, at least considering the present state of the art. The chapter headings are: Introduction; Acids, Alkalies, and Salts; Water; Oils and Fats; Soap; Chlorine Bleaching Agents; Peroxide; Sulphur Bleaches; Blues and Blueing; Starches; Textile Fibres; Stain Removal.

Outlines of Metallurgy

METALLURGY AND ITS INFLUENCE ON MODERN PROGRESS. With a Survey of Education and Research. By *Sir Robert A. Hadfield, Bt.*, past president, Iron and Steel Institute; past president, Faraday Society, vice-president, Inst. Mech. E., etc. D. Van Nostrand Company, New York. 388 pp. Price $7.50.

Hadfield's book is an interesting combination of the historical, scientific and economic aspects of ferrous metallurgy. For the most part it is written in a popular vein, although a vast amount of technical information, tabular, graphic and critical discussion is distributed through the sections on metallurgy and fuel economy. The book is divided into 4 parts, with the following constituent chapter headings: Part I—Historical: The Birth of Science—The Rise of Steam—The Twentieth Century; Part II—Metallurgy: The Importance and Antiquity of Iron—The Rise and Importance of Alloy Steels—Manganese Steel—Silicon Steel—Heat Treatment and Microstructure of Steel—Application of Special Steels; Part III: Fuel Economy; Part IV: The Rise of Education and Research—Educational Methods and Facilities—Scientific Societies.

Reading of the book imparts a fresh realization of the power of science and technology—not alone of metallurgy—in world affairs.

Mathematics for Engineers

MATHEMATICS FOR ENGINEERS. By *Robert W. Dull*, consulting engineer; member, American Society of Mechanical Engineers; member, Western Society of Engineers. McGraw-Hill Book Company, Inc., New York. 780 pp. Price $5.

This book is unusual in that it is an outgrowth of the author's engineering practice, more especially in consulting, and as a consequence it is written with the needs of graduate engineers in mind. Most texts on mathematics, whether the subject be elementary algebra or the advanced calculus, are intended primarily for mental discipline. This the immature student needs. On the other hand, the engineer in the office or factory needs a different kind of book, one not encumbered with mental exercises, but striking at the root of fundamentals and giving appropriate applications.

To the reviewer it seems that the needs of the mature engineer have been met and in an adequate fashion. "Mathematics for Engineers" is a complete treatise on the usable mathematics, from arithmetical computations to partial and multiple integration. It fully lives up to the following statement by the author: "This treatise on mathematics has been prepared primarily for engineers. In this we would include (1) engineers who want a quick and convenient reference, (2) engineers who have grown somewhat rusty in their mathematics, and (3) engineers who feel the need of a text for the study of mathematics."

Chlorination of Zinc Sulphide

A patent to E. W. Hale and Colin G. Fink (U. S. No. 1,588,679) on a process for the extraction of metals from sulphides is particularly applicable to the extraction of zinc from blende. These inventors discovered that the chlorination reaction with zinc sulphide, although slow in the case of chlorine, is violent when bromine is used. The primary stage in the reaction is a direct replacement of the sulphur by bromine.

Readers' Views and Comments

An Open Forum

The editors invite discussion of articles and editorials or other topics of interest

Reed vs. A. E. Little & Company: A Possible Misunderstanding

To the Editor of Chem. & Met.:

Sir—On page 492 of your issue for August there is a digest of the decision of the Supreme Judicial Court of Massachusetts in the case of Reed vs. A. E. Little & Company. We now find, to our surprise and somewhat to our chagrin, that certain of our friends are under the impression that the defendant in this suit was Arthur D. Little, Inc. Will you therefore kindly permit us to inform your readers that Arthur D. Little, Inc., or its officers have no connection or relationship with either parties to the suit in question.

A. D. LITTLE.
President, Arthur D. Little, Inc.

Charles River Road
Cambridge, Mass.

Citric Acid Obtained from Pineapples in California

To the Editor of Chem. & Met.:

Sir—I note from the article on "Marketing of Tartaric and Citric Acids" appearing in the August number that the author has apparently overlooked one source of citric acid that is unique.

For quite a few years, the California Packing Corporation has been taking pineapple waste and recovering every portion of it as valuable byproducts. One of these is calcium citrate, which, at the present time, is being recovered at the rate of about 250,000 lb. per year, I believe, and the figures are increasing each year. In the past the acid has been produced from this material at the United Chemical Works, Corona, Calif.

B. M. PILHASHY,
Consulting Chemist.

San Francisco, Calif.

Efficiency of the Tentelew Process for Sulphuric Acid

To the Editor of Chem. & Met.:

Sir—I have just received a letter from Mr. A. Harmuth written in Germany. Mr. Harmuth was joint inventor with Dr. Eschellman of the well known Tentelew contact process. They were both connected with the Tentelew Chemical Works in St. Petersburg, Harmuth as Chief Engineer and Eschellman as Technical Director. Harmuth writes that he has read an article in the *Zeitschrift für Angewandte Chemie*, No. 26 of July 1, 1926, containing a reprint from *Chemical & Metallurgical Engineering* of April, 1926, page 204, by Chaplin Tyler, giving certain comparative figures regarding the contact systems Tentelew, Schroeder-Grillo and Mannheim. Mr. Harmuth in commenting on this article says:

"According to these figures, the Grillo process surpasses the Tentelew and all other ones. For instance, the conversion of the Tentelew process is quoted as 84.2 per cent against Grillo's 94 per cent, besides which the repairs and wages are mentioned as less favorable and consequently also the total cost, which does not correspond to the actual facts. Inasmuch as you are familiar with the operation results of Tentelew, I wish to inquire if it would not be possible for you to ask that a correction be published in the American journal."

I am very glad, indeed, to be able to give some facts regarding the Tentelew process. This process, as you may know, was introduced by me in the works of the Merrimac Chemical Company at North Woburn in 1906 for the first unit and 1914 for a second unit. When the contact mass was new, conversions of between 97 and 98 per cent were regularly obtained, and after ten years operation with the same contact mass, and at a considerably higher rate of production, 96 to 96½ per cent was regularly obtained. The figure of 84.2 per cent conversion for the Tentelew process is ridiculous, and if true, only represents most inefficient operation.

In my opinion both the chemical and engineering features of the Tentelew process were worked out in a most efficient manner by Eschellman and Harmuth and will stand comparison with the very best contact processes in use today.

HENRY HOWARD,
Past President, American Institute of Chemical Engineers.

1300 Guardian Bldg., Cleveland, Ohio.

To the Editor of Chem. & Met.:

Sir—The data on the efficiency of the Tentelew process, to which Mr. Howard refers, were published originally in the "Second Report on Costs and Efficiencies for H. M. Factories Controlled by Factories Branch, Department of Explosives Supply," which is an official British Government report of Sept. 10, 1918. The figures, which unquestionably are authentic, represent operation of the Pembrey Tentelew plant for a period of 6 months, during which time 6,334 tons of oleum was produced at a mean over-all efficiency of 84.2 per cent. The report does not state the conversion efficiency, which presumably would be somewhat higher than the over-all efficiency.

I should also call your attention to a statement by F. D. Miles on p. 371 of his recent book, "Manufacture of Sulphuric Acid (Contact Process)":

"In the published records (*Second Report on Costs and Efficiencies of H. M. Factories*, p. 30, 1918) the Tentelew plant at Pembrey is reported to have worked, during the first six months of 1918, with a mean over-all efficiency of 84.2, the highest figure reached for any one month being 86.2 per cent. For the second month of this period, the following figures may be quoted (*Report on the Statistical Work of the Factories Branch*, p. 15, 1919).

Pyrites charged (48 per cent S), 119.8 tons. Equivalent SO_3 = 299.5 tons.
Feed acid charged—
Absorption, 349 tons (92 per cent) } Equivalent
Drying, 182.8 tons (92.5 per cent) } SO_3 = 262.3 tons.
Acid produced—
Oleum, 604.3 tons (85.65 per cent SO_3) Equiv. SO_3 = 517.6 tons.
Weak acid, 193.3 tons (87.5 H_2SO_4) Equiv. SO_3 = 169.1 tons.
Cinders, 179.7 tons (S = 2.3 per cent) = S = 4.1 tons.
Net SO_3 made in plant = 255.3 tons.
Net SO_3 lost in plant = 44.2 tons.
Recovery of sulphur charged = 85.2 per cent.
Recovery of sulphur burned = 88.3 per cent."

CHAPLIN TYLER.

New York, N. Y.

Selections from Recent Literature

Varnishes. Formulas are given for various varnishes including the following types: bituminous, gilding, drying, elastic and white varnishes. G. Couret, *Rev. gen. des Mat. Plastiques*, July, pp. 447-50.

Casein Plastics. Processes and equipment for commercial production of casein and for converting it into hardened and plastic materials; illustrated. Great care is necessary in the drying, grinding and purification (by magnetic separation) of casein. Marc Fontaine, *Rev. gen. des Mat. Plastiques*, July, pp. 435-42.

Acid-Proof Iron. The present status of acid-resisting ferrous alloys is reviewed. Calite, Alite and the Ni, Cr and Si steels receive particular attention. Illustrated. T. Hoffman, *Chem. Apparatur*, June 25, p. 140; July 10, p. 152.

Lithopone. Statistics of production and consumption in various European countries, in the Americas and in Australia. Tariffs, local factors and foreign trade competition are discussed. *Chem. Ind.*, July 24, pp. 638-41.

Fertilizers. Large tracts of land in India and other parts of the world are poor in nitrogen. Growth in population, with increasing demand for food and textiles, will soon make it necessary to cultivate the poorer land, and so there is a large potential demand for the nitrogen fertilizers. *Chem. Industrie*, July 31, pp. 662-4.

Lead-Chamber Acid. The chemical theory of the formation of sulphuric acid in the lead chamber process is reviewed, with particular attention to the theories of Rossignol and of Bitterli. Andre Graire, *Chem. et Ind.*, July, pp. 3-15.

Oil Heating. Illustrated description of the construction and use of equipment for heating reaction vessels and the like with circulating oil at high temperatures (up to 245 deg. C.). Neither oil nor hot water is the last word in heating for industrial processes; both are steps on the way to heating with high pressure steam. Th. Hoffman, *Chem. Apparatur*, May 10, p. 118; July 10, pp. 154-5.

Pyroxylin Solutions. In a search for the reason why ether-alcohol is a much better solvent for pyroxylin than either liquid alone, it was found that associated alcohol molecules are active in the peptization, and that ether favors association of the alcohol. Ether is not a peptizing agent at any temperature; alcohol is active at low temperatures or in presence of liquids which favor association. Since water inhibits association of alcohol, the ether should be dry. M. L. Byron, *J. Phys. Chem.*, Aug., pp. 1116-24.

Sugar Refining. Entrainment losses in the vacuum evaporation of sugar are not large; the probable maximum is about 0.1 per cent or a little less. Unexpectedly, the ash in the entrainment solids is much higher than in the original solution. This is attributed to decomposition of organic salts. C. F. Bardorf, *Can. Chem. & Met.*, Aug., pp. 175-7.

Electrolytic Lead. The thermal behavior of a very pure sample of electrolytic lead (99.79 per cent Pb) for type metal indicated that the metal exists in 3 modifications. Of these, one is stable below 60 deg. C., one above 180 deg. C. and one in the range between. The purest obtainable lead contains traces of other metals, such as tin, in solid solution; and these impurities may have some influence on the observed modifications. A. Travers and Houot, *Compt. rend.*, Aug. 2, pp. 359-61.

Ore Handling. New stationary machines for tilting cars of ore, coal and the like. Illustrated. *Chem.-Ztg.*, Aug. 4, pp. 576-7.

Water Glass. Modern practice in the manufacture of the soluble silicates. Among the difficulties are discoloration of the product, and disposal of the filter-press sludge. R. Deckert, *Chem.-Ztg.*, July 21, pp. 535-6.

Electrolysis. A chart showing current yield, bath voltage and energy consumed for industrial processes of electrolysis. Robert Nitzschmann, *Chem.-Ztg.*, July 17, p. 525.

Viscose Silk. Processes and appliances used in making filaments from viscose; illustrated. Carlo Sandoz and Giulio Tocco, *Giorn. chim. ind. appl.*, June, pp. 319-26.

Lead Refining. The Harris process for refining lead has been gaining ground rapidly. It has the advantage that the impurities can be recovered and worked up separately for arsenic, tin, etc. Schott, *Z. angewandte Chem.*, July 15, p. 867.

Catalytic Oxidation. The vapor-phase oxidation of naphthalene to phthalic acid is so successful that anthracene can now hardly compete (without credit for by-product recovery) with phthalic anhydride as a source of anthraquinone. Vapor-phase oxidation of benzene to maleic acid is also profitable; and the process can be applied also to toluene and other aromatic compounds. Illustrated. C. R. Downs, *J. Soc. Chem. Ind.*, July 2, pp. 188-93T.

Chemical Equipment. Meldrum metal, aluminum, vitreosil, enamel ware, Monel metal and various other alloys are all contributing toward the fight against corrosion in chemical processes. Illustrated, Arthur Grounds, *Ind. Chemist*, July, pp. 296-300.

China Clay. Notes on the properties, grades, uniformity and uses of china clay. E. J. Lewis, *Ind. Chemist*, July, pp. 307-8.

Wastes. Illustrated description of garbage incineration, refuse destruction, tin can recovery, fat and grease reduction plants, and other waste disposal methods in cities of Europe and America. J. B. C. Kershaw, *Ind. Chemist*, July, pp. 309-14.

Coking Coal. Washing and drying coal; refractories; waste heat; gas and benzol recovery; tar, quenching coke; low-temperature carbonization. H. M. Spiers and T. C. Finlayson, *Ind. Chemist*, July, pp. 315-8.

Steels. Alloy steels for chemical plant construction are now available in a considerable variety. The Ni steels are resistant to many chemical influences; with the aid of Cr, Mo, Cu, Si and other elements the range of desirable properties for special chemical uses is greatly increased. An appendix gives a table of comparison of the effect of many chemicals on mild steel, Cr steel and Cr-Ni steel. W. H. Hatfield, *J. Soc. Chem. Ind.*, Aug. 13, pp. 568-73.

Particle Size. A symposium, at a joint meeting of the Institution of the Rubber Industry and the Oil and Colour Chemists' Assn., on the influence of particle size in the paint and rubber industries. *J. Soc. Chem. Ind.*, Aug. 13, pp. 574-7.

Sugar from Wood. Illustrated description of the Rheinau and the Prodor processes for hydrolyzing wood. Plant and equipment for these processes, and for certain modifications, are shown in diagrams. A combination of the Rheinau and Prodor processes has been tried, both with and without a digester. W. R. Ormandy. *J. Soc. Chem. Ind.*, Aug. 13, pp. 267-73T.

Surface Combustion. The all-round efficiency of heating by surface combustion is much greater than for other types of burning. Any combustible gas can be used for surface combustion. A principal advantage is that the combustors can be made in any shape for heat treatment of particular articles, e.g. circular for heating steel tires to be shrunk onto wheels. T. G. Tulloch, *J. Soc. Chem. Ind.*, Aug. 13, pp. 280-7T.

Paving Materials. Modern traffic conditions demand thorough supervision of the quality of concrete, asphalt, tar, rock and other paving materials. Resistance to oil and weathering, high impact strength and abrasion resistance are among the essential properties. These must be controlled in manufacture and checked by inspection and testing. E. Neumann, *Z. angewandte Chem.*, July 20, pp. 915-6.

Steel. Special chemically-resistant steels, for high pressures and temperature such as in the Haber process, are being developed in England. Various Ni-Cr steels are giving excellent results in resisting acids, hot gases, and stresses at high temperature. Illustrated. T. G. Elliott and G. B. Willey, *J. Soc. Chem. Ind.*, July 30, pp. 526-34.

Fat Extraction. Illustrated description of a new plant layout in which large production depends on rapid and efficient operation rather than on large equipment units. L. J. Simon and J. W. Hinchley, *J. Soc. Chem. Ind.*, July 30, pp. 252-7T.

Corrosion. A lecture on fundamental principles; influence of such factors as physical structure of the metal, chemical nature of the surrounding medium, etc. U. R. Evans, *J. Soc. Chem. Ind.*, July 23, pp. 504-8.

Coking of Coal. Various theories of the cause of coking are reviewed. Much research is needed before the true in-

fluence of resins and other coal constituents will be understood. Plasticity and the physical structure and condition of the coal also still require study. Fine grinding is apparently beneficial to agglutinating power. R. Quarendon, *J. Soc. Chem. Ind.*, July 9, pp. 468-70; July 16, pp. 483-7.

Sulphur Dioxide. The use of SO_2 as a reducing agent is so well established that its possibilities as an oxidizing agent have been neglected. It is useful, for example, in making the formaldehyde-sulphoxylates and in oxidizing the lower chlorides of Fe, Sn, Cu and Hg. Its reduction products are the lower oxides of S (which with water give thionic and other acids), and H_2S. Wm. Wardlaw, *J. Soc. Chem. Ind.*, July 16, pp. 210-4T.

Starch Hydrolysis. In converting starch to glucose, the kinetics of the reaction indicate a complex series of intermediate stages. It is difficult to follow the formation and breaking down of the successive starch sugars, because there are no certain and reliable methods analysis. D. R. Nanji and R. G. L. Beazeley, *J. Soc. Chem. Ind.*, July 16, pp. 215-9T.

Meat Freezing. Though one of the largest industries, the chemistry involved in the preservation of meat by freezing is not very thoroughly understood. Scientific control is making some progress in the industry, but fundamental chemical research is greatly favored. In mechanical devices and sanitation there is little left to be desired. H. C. Ross, *J. Soc. Chem. Ind.*, July 2, pp. 445-6.

Aerosols. Dust explosions and occupational diseases are among the consequences of inadequate control of industrial dusts and smokes. Air filters, electrical precipitators, dust collectors or ventilating systems should be used according to conditions. W. E. Gibbs, *J. Soc. Chem. Ind.*, July 2, pp. 183-8T.

Petroleum. The danger of explosion of carbureted atmospheres in petroleum and distillate storage tanks is discussed in the light of the results of an investigation into fire dangers in petroleum refineries. A. Williams-Gardner, *J. Inst. Petr. Techn.*, 1926, vol. 12, pp. 336-40.

Decolorizing Carbons. The value of decolorizing carbons in the refining of sugar is discussed. A. A. Blowski and J. H. Bon, *The Int. Sugar Journal*, 1926, vol. 28, pp. 367-70.

Petroleum. The principle and economy of the Dubbs cracking process. F. Meyer, *Brennstoff-Chemie*, 1926, vol. 7, pp. 232-5.

Synthetic Resins. Review of the synthetic resin industry based on the polymerization of unsaturated hydrocarbons. W. Urbanus, *Kunststoffe*, 1926 vol. 16, pp. 144-5.

Lithopone. Review of the world's lithopone industry. Anon, *Die Chemische Industry*, 1926, vol. 49, pp. 662-4.

Flow of Gases. Measurement of gas flow with special reference to the practical application of the dynamic method. O. Mattner, *Chem. Ztg.*, 1926, vol. 50, pp. 533-4; 574-6.

Evaporation. The advantages of evaporation under pressure as applied to various industries are discussed. K. Thormann, *Chem. Ztg.*, 1926, vol. 50. pp. 536-7.

Corrosion and Erosion. Some problems of the heavy chemical industry with special regard to the centrifugal and the steam-air injector (lifter) in the manufacture of ammonium sulphate as ordinarily conducted at gas and coke oven works. P. Parrish, *Chem. & Ind.*, 1926, vol. 45, pp. 593-7.

Dyestuffs. Progress in the dyestuff industry in the year 1925. (Cont.). F. Mayer, *Chem. Ztg.*, 1926, vol. 50, pp. 514-6; 565-7.

Extraction. A review of new methods and apparatus available for the extraction of finely divided materials. H. Jungwirt, *Chem. Apparatur*, 1926, vol. 13, pp. 161-3.

Sulphuric Acid. Construction, operation and operating data of a new automatic nitrate economizer for lead chamber plants in which the nitric oxides are produced from sodium nitrate and sulphuric acid in immediate connection with the Glover tower. Anon, *Chem. Ztg.*, 1926, vol. 50, pp. 538-9.

Steam Lines. The economy of steam line insulation. Fr. Brük, *Chem. Ztg.*, 1926, vol. 50, pp. 537-4.

Rayon. The storage of carbon bisulphide in the viscose plant. E. Wurtz, *Chem. Apparatur*, 1926, vol. 13, pp. 165-6.

Materials of Construction. Test data on the chemically resistant high-silicon copper alloy "Rotoxit." W. Denecke, *Korrosion*, 1926, vol. 1, pp. 13.

Materials of Construction. Pipe connections in enameled apparatus. B. Block, *Korrosion*, 1926, vol. 1, pp. 13-4.

Fusel Oil. The sources, chemical composition and methods of production of fusel oil. E. Lühder, *Der Apparatur*, 1926, vol. 38, pp. 163-5.

Oil Shale. The distillation of oil shale in revolving furnaces. E. Fleischmann, *Brennstoff-Chemie*, 1926, vol. 7, pp. 229-32.

Government Publications

Prices indicated are charged by Superintendent of Documents, Washington, D. C., for pamphlets. Send cash or money order; stamps and personal checks not accepted. When no price is indicated, pamphlet is free.

Analyses of Tennessee Coals. Bureau of Mines Technical Paper 356. 15 cents.

Mineral Production Statistics—separate pamphlets from Bureau of Mines on: Cement in 1924, by E. F. Burchard and B. W. Bagley; Gold and Silver in 1924 (General Report), by J. P. Dunlop; Gold, Silver, Copper, Lead, and Zinc in Nevada in 1924, by V. C. Heikes; Flourspar and Cryolite in 1925, by Hubert W. Davis.

Mineral resources of the United States in 1925 (Preliminary Summary). This gives a summary of data issued in mimeographed form, in the preliminary estimates. Assembled by Martha B. Clark, Bureau of Mines. 20 cents.

Mineral Statistics for 1925—Preliminary estimates in mimeographed form from Bureau of Mines on: Barytes and Barium products; Natural Abrasives; Talc; Gypsum; Mica; and Gold, Silver, Copper, Lead, and Zinc in Oregon, California, and Idaho.

Fourteenth Semi-Annual Motor Gasoline Survey, by E. C. Lane, J. M. Devine, and Peter Grandone. Bureau of Mines Serial No. 2765.

Manufacture of Lime from Small Stone with a Sintering Machine, by W. M. Myers. Bureau of Mines Serial No. 2762.

Nitrogen Fixation, a New Form of Agricultural and Military Insurance. Fixed Nitrogen Research Laboratory.

Benzol Poisoning as an Industrial Hazard, by Leonard Greenburg. Three additional parts in Public Health Reports for July 23, 1926.

Phosphorus Necrosis in the Manufacture of Fireworks and in the Preparation of Phosphorus, by Emma F. Ward. Bureau of Labor Statistics Bulletin 405. 15 cents.

Safety Code for Paper and Pulp Mills. Bureau of Labor Statistics Bulletin 410. 15 cents.

Instructions for the Operation, Care, and Repair of Compressed Air Plants. Reprint of Chapter 18 of the Manual of Engineering Instructions, Navy Department, Bureau of Engineering. 5 cents.

Instructions for the Operation, Care, and Repair of Refrigerating Plants. Reprint of Chapter 17 of the Manual of Engineering Instructions, Navy Department, Bureau of Engineering. 25 cents.

Second Report of Adhesives Research Committee

This report covers the period of three years since the Adhesives Committee's first report of 1922.

A clear step forward in the study of the chemistry of gelatin has been made by the production of a gelatin of high purity. It appears that the product is not a definite chemical entity, and it is noteworthy that highly purified gelatin is not, as has often been stated, a poor adhesive, but differs little in this respect from ordinary high-quality glues.

A method has been elaborated for the extraction of high-grade gelatin from bones in a far shorter time than has hitherto been possible and should prove of practical value. But an achievement which should have important economic results is the development of a method of extracting an *odorless* and *tasteless* gelatin of high adhesive value by simple treatment from fish skins. This result should point the way to further inquiries which might well lead to great developments, through the elimination of offensive smell and taste in those industries which depend on fish for their raw material.

Investigations designed to throw light on the fundamental nature of adhesion have been undertaken, and have already enabled some tentative conclusions to be drawn.

The "Second Report of the Adhesives Research Committee" may be obtained from H. M. Stationery Office, Adastral House, Kingsway, W. C. 2, London, upon payment of 3s., postage extra.

The Plant Notebook

An Exchange for Operating Men

Paint Weighing Capsule For Testing

By I. B. Morgan
Jefferson City, Mo.

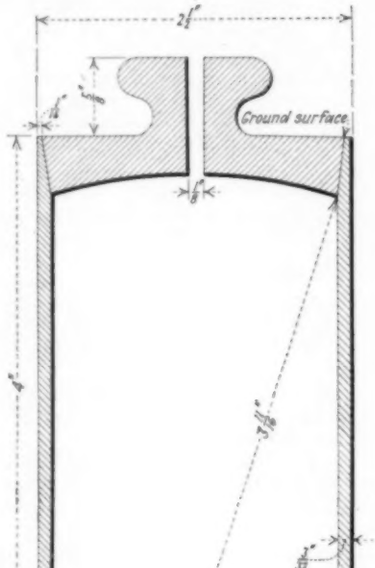
The manufacturers of paints for railroads, government, or highway use, where specifications are rigidly enforced, must have absolute control of the operations in their plants, especially the thinning department, in order to avoid non-acceptance of the finished product.

In the case of simple paints where the pigment, or the vehicle contains only one constituent or any secondary constituent being less than 5 per cent, it is possible to calculate the weight per gallon of paint for varying percentage of pigment. As most specifications call for a certain per cent pigment, the procedure in controlling the manufacture resolves itself into thinning down the ground paste with vehicle until the desired weight per gallon is obtained. Many plants, having control laboratories, are using this method, but the devices used to weigh the paint vary from a small brass cubic-inch cylinder to a standard gallon measure.

The small cubic-inch in the hands of a long experienced operator gives fair results on light weight paints but where heavy paints are weighed, it is almost impossible to strike off the level of material so that two consecutive weighings on the same paint agree. Any error in striking off or weighing is multiplied many times in calculating the weight of a gallon from the weight of a cubic inch and in the case of red lead paint an error amounting to 0.8 lb. may vary the per cent pigment 1.0 per cent.

The standard gallon is undoubtedly superior to the cubic inch but it too has faults. When in the form of a regular gallon measure, it is difficult to determine when the paint is exactly at the gallon level. In the form of a truncated cone this difficulty is minimized but there is inconvenience in cleaning such a measuring device because of the small opening.

The author had a weighing capsule turned out of brass, according to the specifications given in the accompanying drawing, which gave uniformly accurate results when used with a balance of suitable sensibility. The capsule was calibrated by first weighing it empty and then filling with distilled water at room temperature and weighing again. Both weighings were repeated several times and averaged. The difference between the averages gave the volume of the capsule. A curve can be made giving the volumes at various temperatures and the test made at any temperature desired referring to the curve for the correct volume, or, if convenient, all tests can be carried on at one temperature, in which case the volume is a constant.



Paint Weighing Capsule

This capsule, which can be easily made up in the plant shop, is of great assistance in testing paint at paint plants.

In use the capsule was filled with thoroughly stirred paint up to a point about ¼ in. from the top. The cover was then put on firmly with a slight twisting motion. The orifice opening was wiped clean at once with one sweep of a cloth and any ooze which occurred thereafter was allowed to remain. The outside of the capsule was then wiped clean and the weight of the paint and container determined. The weight of the paint alone was found by subtracting the weight of the capsule from the total weight of paint plus capsule. The calculations were then made to determine the weight per gallon of the paint. If the determinations were all carried out at one temperature, including the volume calibration, a single constant was derived which multiplied by the weight of the paint in the capsule gave the weight per gallon of the paint which was being tested without further calculation.

The capacity, while not as great as the standard gallon, is enough more than the cubic inch to materially cut down any additive errors. The variation in volume is reduced to a minimum because of the small orifice at the point of opening. The device is very easily cleaned and is compact enough to be carried into the field to examine paint in any controversy that may occur with a customer.

A Corroded Tank Saved By Welding

The strong sulphuric acid storage tank in a certain plant was showing evidence of corrosion. Someone decided that this would not do at all and proceeded to have the fire hose turned into the tank so that the weaker sulphuric acid would be less active. The consequences were what any chemist would expect, namely, the bottom row of plates almost all around the tank was quickly eaten through and the tank's usefulness seemed at an end.

Fortunately the mechanical staff of the plant were able to salvage the tank readily. An oxy-acetylene cut was made entirely around the tank just above the bottom and again just above the next horizontal row of rivets. The tank was then carefully let down and the two cut edges welded together. If there is less vigorous use of the fire hose it is anticipated that the tank can be continued in useful service for the rest of its normal life. In any event, it represents another striking example of salvage by ingenious use of cutting and welding equipment.

Loading Coal Automatically Into Industrial Cars

By W. E. Grainger
Sparrows Point, Maryland

In connection with the coal handling equipment of a large by-product coke plant a new method of automatically loading coal from a fixed hopper into the moving four-ton cars of a cable railway was developed and is working successfully. The original method of loading these cars from the hopper of the traveling bridge crane which spans the storage field involved a secondary two-ton capacity tilting hopper which was tripped by a trigger on the moving car. In the new method the secondary hopper is stationary and has a bottom sloping toward a door or gate in a vertical position which is hinged at the top. This door is held closed by a latch on each side. The trigger on the cable railway car trips these latches allowing the coal to drop into the moving car. Simultaneously with the tripping of the latches the electric circuit of a solenoid, which holds the door open, is made by means of an extension arm on one of the latches. In this same circuit is a standard dash-pot timing device which is set for the time required to empty the hopper into the moving car. When the electric circuit of the solenoid (which is set in a vertical position and connected to the door by means of two levers and a link), is broken by the timing device the door latches itself, closed by its own weight. This method eliminates the tilting of the hopper and its consequent heavy rebound.

Large Immersion Heater For Liquids

In passing from the laboratory research phase to the semi-plant scale of development work, it is often necessary to heat liquids without the direct application of fire. When no steam coils are available, this may be conveniently done by large immersion heaters. Such a heater is easily made from one of the space heater units marketed by most electrical supply houses at low cost.

A piece of two-inch pipe slightly longer than the heating unit is capped at one end. Asbestos covered wires are fastened to the unit as leads. The unit (which may be obtained in any desired wattage) is then placed in the pipe, the lead wires being brought out from the open end. Care should be taken to insure absence of contact between the lower lead and the unit or the pipe as well as to insulate the binding screws from the pipe. This is best done with mica or asbestos cloth.

The pipe is then filled with a good grade of transformer oil and a two-inch to one-half-inch reducer is screwed on to the open end. This may be a reducing ell if it is desired to use this heater in a horizontal position. A one-half-inch pipe of any desired length is then screwed on to the reducing fitting, the lead wires being brought out to a suitable connector.

The ordinary types of immersion heaters may also be used in the pipes filled with transformer oil, where the amount of heat required is small. In this case the connector plug usually found on the heater itself should be wired permanently in place before the heater is placed in the pipe. Care should be used not to operate either type of heater unless it is immersed in liquid.

Numbers on Up-Take Pipes of Coke Ovens

By Hugh E. Jones
Fairmont, W. Va.

So that the men on top of the coke oven battery can easily distinguish one oven from another, we have found it necessary to develop a suitable paint for numbering the up-take pipe of each oven. Cast iron numbers already existed on the coke side of the ovens, but it was impossible to see these numbers at night because of the heavy coat of smoke and dirt that constantly accumulated on them.

Because of the high temperature of the up-takes, no dirt collects on them, so that white numbers painted there will stay white. But the difficulty is to find a paint that will withstand the heat. Oil base paints blacken, while paints with a solvent such as alcohol ignite. Common salt dissolved in water gave good results but was washed away by rain storms.

Experiment with many substances finally led to the discovery of a practical paint, i e., a suspension of calcium sulphate. This is made in the following manner: A handful of calcium chloride is dissolved in about one-half pint of water. While stirring rapidly, dilute sulphuric acid is added until the white precipitate ceases to form. Rapid agitation is necessary in order to produce a precipitate sufficiently fine to remain easily in suspension. Care must be taken not to add too much acid as any considerable excess tends to darken the paint when applied.

The mixture of calcium sulphate, acid and water should be of a consistency about that of buttermilk. It will not spread on the hot surface quite as easily as oil paint on a cold surface, and therefore a little patience is required in painting the numbers. Experience shows that the best place on the up-take pipes for the numbers is about 15 in. above the top of the battery. At this place the pipes are hotter than higher up and consequently the numbers will remain whiter. The painting should be done in the winter when the weather is cold enough to permit working close to the hot pipes. Once the job is done the numbers will not have to be repainted until the next winter when a second coat can be applied.

Test of Crystallizer Shows Saving

A Swenson-Walker crystallizer was put into service by a large eastern chemical company in August, 1925, superseding tank equipment formerly employed. The savings effected by the unit in labor, floor space and interest on process inventory were so substantial and the quality of crystals produced was so superior to those made by the vat system that a second unit was put into service early in 1926.

Both units are used for crystallizing disodium phosphate and trisodium phosphate and are operated 24 hr. a day, 6 days, and often 7 days a week. A uniformly small crystal is produced, free from fine particles since no crushing is required. No auxiliary refrigerating equipment is needed in hot weather, thus permitting continuous operation.

Each machine consists of 3 superimposed units operating in series. Each unit consists of a 40-ft. double-walled iron shell containing a long pitch screw conveyor. The liquor is supplied to one end of the upper unit and as crystallization proceeds, the mother liquor and crystals are conveyed to the opposite end, then drop to the second deck and are conveyed similarly through the second and third units.

Ocean water is pumped through the 3 double shells in series; but in a direction counter to the flow of liquor in order to maintain a nearly constant temperature differential between water and liquor throughout the circuit.

Rate of flow of both liquor and cooling water are easily controlled, making it possible to maintain the liquor at the required temperature to produce crystals of uniform and correct size.

Disodium phosphate crystals are formed at about 90 deg. F. The liquor is supplied at a temperature of 120 deg. to 140 deg. F. and with a gravity of about 35 deg. Bé.

The discharged liquor goes to storage tanks and then to an evaporator to prepare it for repassage through the crystallizer. The crystals are carried to the floor above by means of a screw conveyor and bucket elevator, for dewatering and washing.

For many years, crystallizing was accomplished with 6x12x2 ft. tanks in which the liquor was held for about 5 days until crystallization occurred. The process was objectionable because of the time required and also because of the non-uniformity of the crystals. There was a tendency to form large crystal masses which required crushing preliminary to the next process and this resulted in breaking down some of the material into dust. The production of each crystallizer has averaged 31,000 lb. in 24 hr. and under ideal conditions has run as high as 40,000 lb.

The table gives the operating costs for the two systems. As the former system was of less capacity than the present, the actual former costs have been increased proportionately to permit comparison for equal capacity. The Swenson-Walker equipment involves a somewhat greater investment and its fixed charges are higher but other items show large savings.

Power costs are not compared. The power required for operating the conveyor agitators, about 6 hp. for each machine, and that required to pump the cooling water for the present system is less than that required to drive the crusher and cooling fans for the old system, for equal capacity.

Comparative Operating Costs, Crystallizers vs. Vat System

	Crystallizers		Vat System with Tanks		Increase	Decrease
Investment in equipment	2 units at $10,000 and $9,000.		80 tanks at $150 plus $2,000			
Depreciation	$19,000 ÷ 8 yr	$2,250	$14,000 ÷ 20 yr	$700	$1,550	
*Average interest at 6 per cent	9/8 x $19,000 x 0.06/2	641	21/20 x $14,000 x 0.06/2	441	200	
Repairs, maintenance and lubrication		500		200	300	
Floor rent	30 x 50 ft. at $0.20	300	36 x 280 ft. at $0.20	2,016		$1,716
Interest on work in process	62,000 at $0.025 x $0.06	93	310,000 lb. at $0.025 x $0.06	465		372
Labor	24 man-hours x 300 days at $0.55		188 man-hours x 300 days at $0.45	25,380		19,530
	14 man-hours x 300 days at $0.45	5,850				
Power (not compared)	(Somewhat less than for vat system)					
					$2,050	$21,618
	Annual saving effected by crystallizers				$19,567	
	Annual return on the investment				103 per cent	
Units per ton of daily capacity						
Investment		$612.70		$451.61		
Plant depreciation, average interest and maintenance		109.39		43.26		
Floor space		48.4 sq.ft.		325 sq.ft.		
Labor		$0.63		$2.73		

*Allowing for interest earned by depreciation reserve.

Equipment News

From Maker and User

Melting Pot

An addition to the Trent line of rapid-heating melting pots has been brought out by Harold E. Trent, 259 N. Lawrnece St., Philadelphia, Pa. This pot, of 10 lb. capacity, is similar to the other sizes already brought out, but embodies a new design of protected plug contacts with which a standard plug can be used to obtain the 3-heat combination.

Gas Filter

For use with its CO_2 recorders, Uehling Instrument Co., Paterson, N. J., has brought out a new special design of their "Pyro-porous" gas filter. This device is used for filtering the flue gas before it enters the recorder.

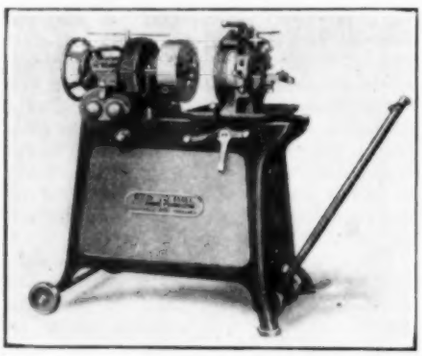
The standard filter is satisfactory for most installations, while the new design is for those special cases where impingement of incandescent particles of ash would seal the disks of the standard type with a slag film. This condition is one met with most frequently in cement kilns and metallurgical processes. The new filter prevents this by means of shields that protect the disks but allow the gas to flow freely through them.

Welder and Compressor

Schramm, Inc., West Chester, Pa., is marketing a combination of gas engine driven compressor and arc welder mounted on a single base. A Schramm compressor and a General Electric welding outfit are used, both driven by a Buda gasoline engine. The unit can be mounted on a standard 2-ton truck or can be made portable by adding wheels.

The engine is a 24-hp., 800 r.p.m. engine, so mounted that it can be started and operated independently of either the compressor or welding generator. The compressor is a 2-cylinder, water-cooled machine with a capacity of 120 cu.ft. per minute, equipped with an automatic unloading device. The air receiver is 16 in. in diameter and 42 in. high. The welding equipment consists of a belt-driven WD-12 arc welder with an idler pulley for belt tightening. By the use of a Borg & Beck 12-in. clutch coupling, either of the machines may be connected to the engine.

It is claimed that this combination will be of great value in field work, the compressor being used to operate tools for preparing and finishing the welding work, thus permitting a complete job to be done with one piece of equipment. The outfit is 8 ft. 4 in. x 5 ft. 11 in. and 3 ft. 10 in. high. Its weight is 4,000 lb.



Portable Pipe Threading Machine

Pipe Machine

A new portable pipe machine has been brought out recently by Hall-Will, Inc., Erie, Pa. This machine, shown in the accompanying illustration, threads and cuts pipe and bolts, pipe from ¼ to 2 in. and bolts from ¼ to 1¼ in. It can also be used as a power drive for hand stocks up to 12 in.

The machine can be converted to a stationary unit in a short time. It weighs 450 lb. The drive is by silent chain and friction clutch from a 1 hp. motor. Timken bearings are used on drive shafts. There are 3 speeds. Close nipples can be threaded without extra equipment. The shortest piece of pipe that can be cut off is 7 in.

Batch Mixer

For mixing thoroughly such soft and finely divided materials as dry colors, water paints, whiting, clay, lamp black, soda, pulverized sugar, cocoa and milk powder, Robinson Mfg. Co., Muncy, Pa., have brought out a new design of batch mixer. This machine is claimed to break up and smooth out all small lumps or balls and to give an intimate mixture.

The mixing mechanism consists of a series of trowel shaped mixing blades that act on the material somewhat in the manner of a trowel in the hands of a workman. These blades are curved to a radius to fit the trough and are so mounted as to produce their action over the full length of the mixer. They are adjustable for mild or severe action. In addition to these trowels the regular scroll conveying blade and adjustable paddles used in this company's other mixers are also mounted on the shaft in order to keep the material moving back and forth during mixing.

When the mixer is to be used to mix materials having a tendency to flake or smear, the rear edge of the blades is arranged with diagonal corrugations so that the material is continually broken up and kept in powder condition.

Combustion Tester

A testing outfit designed for the purpose of making quick determinations of combustion efficiency and determining the cause and location of trouble, has recently been placed on the market by the Hays Corporation, Michigan City, Ind. This outfit consists of a portable flue gas analyzer, a steel armored flue gas thermometer and a draft gage, all arranged in a compact case.

The gas analyzer is the familiar Hays type which can be used for the determination of CO_2, carbon monoxide and oxygen. The draft gage is an adjustable inclined tube 9 in. in length and 4 in. in height, with a range of ½ in. of water either draft or pressure, in hundredths. Both the analyzer and the gage are self contained in leather cases and can be carried each independently of the other. The case which holds all three items is 4x14x18 in. with a weight when loaded of less than 20 lb. In addition to the 3 instruments there is also room in this case for a few tools and a suit of coveralls.

Motor Control

A completely self contained, all immersed, automatic starter for 2,300 volt synchronous motors has recently been developed by the Electric Controller & Mfg. Co., Cleveland, Ohio. This starter is built for across-the-line starting of slow-speed motors and for reduced voltage starting of high-speed motors. To operate it, it is simply necessary to push a button to start the motor and, as the motor approaches synchronous speed, the field excitation is automatically applied.

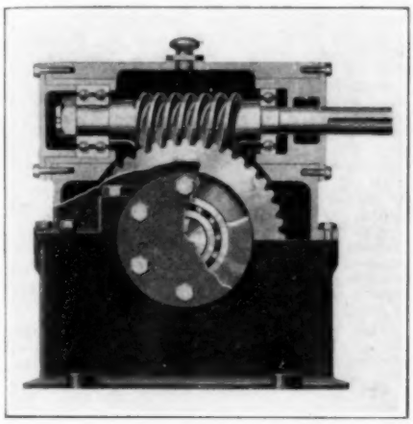
The reduced voltage starter consists of a welded boiler plate tank which contains an automatic double throw switching mechanism, a power transformer for providing starting voltage, potential transformers for providing 220 volts for the master switch operating current, and the current limit transmission relay which connects the motor to full voltage when it has been accelerated with approximately 85 per cent of synchronous speed.

On the outside of the tank there is a dust-proof steel cabinet which incloses a field switching mechanism, field discharge resistors, timing relay and d.c. field ammeter. This cabinet may also contain an automatic starter for operating a magnetic clutch.

The full voltage starter is of similar construction except that the starting autotransformers are omitted. This equipment is complete in a single unit. It makes possible the floor mounting of all of the equipment necessary for starting synchronous motors.

Speed Reducer

A new design of worm gear speed reducer has been developed by William Ganschow Co., Chicago, Ill. It is fully enclosed in a cast-iron housing as shown in the illustration. All moving parts are completely protected by the casing and run in oil, the base of the housing serving as an oil reservoir. The housings are symmetrical, so that the shafts can be reversed.



Worm Gear Speed Reducer

A special bronze gear is standard equipment on these reducers. Worms are of 3½ per cent nickel steel. Antifriction thrust bearings and either ball or roller bearings to suit the application are supplied. The span of the worm bearings is kept as short as possible in order to minimize the deflection of the worm shaft. The span of the gear bearing mounting is wide in proportion to the pitch radius of the gear in order to minimize the radial load caused by the twisting force of the gear. The gear bearings are held in place by clamping plates. The front radial worm bearing is free to float in order to compensate for any elongation of the worm or expansion of the housing. Bearing sizes are calculated for starting torque load concentrated on one bearing.

Feed Water Regulator

Atlas Valve Co., Newark, N. J., is marketing a new valve and control for boiler feed regulation. The device consists of a regulator which is attached to the top of the water column or other appropriate place in the boiler and a control valve which is installed in any convenient point in the feed water line. This regulator, which has no moving parts, consists only of a hollow casting with an inlet, an outlet, and a port for connection to the control valve. The inlet is at the bottom and from it a supply pipe dips into the water column or the boiler, ending at the point where it is desired to maintain the water level.

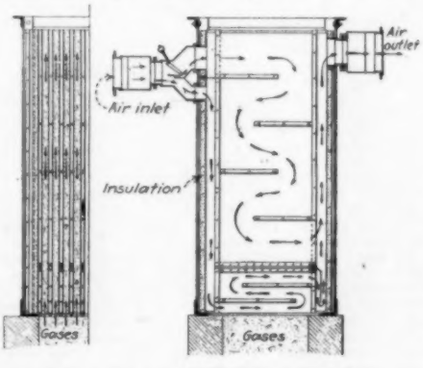
If the water in the water column or boiler should be slightly below the lower, open end of the supply pipe steam will then pass into the regulator through a small orifice. But because this orifice is small the steam expands when it enters the hollow body of the regulator casting, dropping in pressure to about 10 per cent of the boiler pressure. This steam then passes out of the regulator body through a second orifice which is slightly larger than the inlet orifice. These orifices are proportioned to maintain the pressure in the regulator at the relation to the boiler pressure mentioned above, i.e., 10 per cent. The diaphragm of the control valve is connected to this regulator by pipe, so that the reduced pressure in the regulator body acts on the diaphragm. This diaphragm acts against a spring and the pressure in the regulator as given above is not sufficient to close the valve. Consequently it remains open and water is fed to the boiler.

After a time this will raise the water level above the bottom end of the supply pipe, and hot water instead of steam will then flow into the regulator through the orifice. On reaching the chamber in the regulator, some of this hot water will immediately flash into steam, with the result that a pressure of about 60 per cent of that in the boiler is produced, which pressure is sufficient to close the regulating valve by acting on the diaphragm through the pipe mentioned above. As this valve closes the water supply will be shut off and will remain shut until the water level drops below the end of the pipe again, and a lower pressure is produced in the regulator chamber.

Recuperator

An air preheater or recuperator that differs somewhat from other designs is being marketed by Mantle Engineering Co., Pittsburgh, Pa. Instead of being designed on the counter-current flow principle this recuperator is designed so that part of the air, on first entering, comes in contact with the hottest surfaces. This is said to give a greater rate of heat transfer and also to insure that the metal in the region of the hottest gases is always cool enough for safe working.

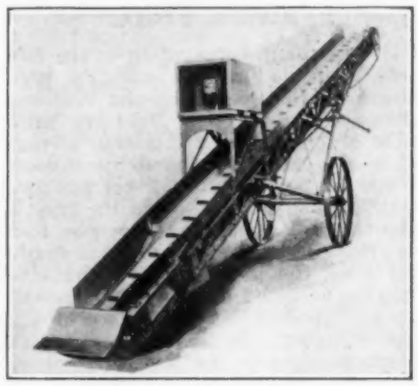
Referring to the accompanying sketch, it will be seen that the incoming air is divided into 2 streams, one being led to the lower part of the recuperator where it passes between plates heated by the hottest incoming gas. The other stream passes between the plates at the top of the recuperator and is guided by baffles in a downward, counter-current direction. These two streams rejoin part way down the recuperator, thence passing up and out. The recuperator is built of metal, to withstand any temperature up to 2,200 deg. F. It is thoroughly insulated against heat losses. Care has been taken in the design to avoid any possibility of leakage.



Side and End Sectional Elevations of Unit Recuperator

Portable Conveyor

A new portable belt conveyor, particularly adapted to yard service, has recently been placed on the market by the Jeffrey Mfg. Co., Columbus, Ohio.



New Portable Belt Conveyor

This conveyor, shown in the accompanying picture, embodies improvements in design to make it more suitable for handling materials from hopper bottom cars to storage or trucks and for reclaiming from storage.

Four new features are:

1. Steel side boards which are bent to extend under the side of the belt forming with belt a moving trough which provides larger capacity and prevents lumps from rolling off.

2. An improved type of carrying idler to support the loaded portion of the belt.

3. An extended and flared loading leg at the bottom, edged with belting material to form a seal with the moving belt. The flared hopper also centers the load on the conveyor.

4. An efficient gate at the foot of the conveyor to prevent material from falling into the enclosed boot housing.

This machine is built in 18, 24 and 30 ft. lengths, and is furnished with electric or gasoline motor, as desired. The height is adjustable by means of a screw. The foot of the conveyor is low so that it will readily enter a pile of loose material. Belt is 16-in. rubber covered and runs troughed.

Static Condenser

A line of static condensers for individual motor application on circuits of 220, 440 and 550 volts for 2 and 3 phase circuits, has been developed by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. The new condenser consists of insulation inclosed in a sheet metal container, and a porcelain terminal housing arranged for conduit connection.

The correction at the motor by means of these static condensers is said to be

productive of a number of advantages: Low losses of less than ½ per cent regardless of kva. rating; power factor, correction at or very near the source as desired; improvement of voltage regulation at the motor or on the feeders, due to the reduction of line current and flexible localized form of correction.

The condensers may be connected at the motor side and switched on and off with the motor without additional attention. All live parts are completely covered to insure safety to operator. The sizes available are ½, 1, 2½ and 5 kva. units.

Steam Trap

A new steam trap known as the ball seat trap No. 4B has recently been placed on the market by the Williams Gauge Co., Pittsburgh, Pa. The principle of operation of this trap is that of a ball valve regulated by a float. When the float is in the lower position, that is when water level in the trap is low the ball is held close to the seat and leakless. As the water in the chamber rises the float rises also but the trap is designed not to open immediately. The ball is held in place by the water pressure in the trap body until the float rises to the highest position, at which time a cage constructed for the purpose pulls the ball away from the seat and allows the trap to discharge. The result is full opening at once and consequently a quick discharge of the trap. When the water is discharged the float lowers and the ball valve is again closed. This closure is accomplished by the pressure of the water flowing from the trap which seats the ball and holds it firmly in position.

Container

Holden Laboratories, Inc., Chicago, Ill., have recently placed on the market a grease container which can be used, among other uses, as a vehicle for filling a grease gun. This container is called the "Cantube."

In the construction of this container an envelope of suitable material is suspended inside a fiber tube, which is crimped in at the top and attached to a fiber plug at the bottom. By rotating the bottom plug, the envelope or bag is twisted and its contents forced out of the top of the container. The material of the bag is varied to suit the material being handled. In this way the container can be used for any plastic substance where the evacuatory feature is an advantage over a container of ordinary type.

This container can be made practically air tight, the bag being airproof and the fiber tubes being capable of being rendered very air-exclusive. This is of value when the container is used with highly evaporative substances, especially those in the alcohol class such as chloroform and carbon disulphite. These tubes are of laminated construction and the final layer of paper is put on over a layer of glue and metallic dust, being passed under heavy rollers which squeeze the particles of metallic dust flat. The container is said to have the advantages of the collapsible tube in addition.

Manufacturers' Latest Publications

Roller-Smith Co., 233 Bway., New York, N. Y.—Bulletin No. 810—A bulletin of radio frequency ammeters, milli-ammeters, and current squared meters of the thermal type.

Adam Hilger, Ltd., 24 Rochester Place, Camden Road, London, N. W. 1, England.—A leaflet describing water jacketed tubes for temperatures up to 100 deg. C. for use with powerful solvents.

Lennox Foundry Co., Ltd., Glenville Grove, London, S. E. 8, England.—Catalog entitled "Chemical Plant and Tantiron" describing the use of this alloy in making chemical equipment.

The Ferro Enameling Co., Cleveland, Ohio.—A booklet entitled "Men and Methods" describing the organization of this company and its facilities, also a booklet on burning equipment for use in enameling work.

Toledo Metal Furniture Co., Toledo, Ohio.—Several new leaflets describing metal furniture for factory and office use.

Keystone Lubricating Co., Philadelphia, Pa.—A booklet entitled "The Keystone Safety Lubricator" describing the lubricating system employed by this company.

Taber Pump Co., Buffalo, N. Y.—Three new leaflets, one on Taber sump pumps, one on midget sump pumps, and the third on type R rotary pumps.

W. S. Rockwell Co., 50 Church Street, New York, N. Y.—Bulletin No. 270—Describing oil and gas burners for use with industrial heating furnaces.

Monitor Controller Co., Baltimore, Md.—A celluloid card giving tables showing the allowable carrying capacity of wires and the ampere ratings of A.C. and D.C. motors at full load.

Centripact Machinery Co., Los Angeles, Calif.—A catalog of the Agnew centrifugal impact mills.

Victor Hybinette, Wilmington, Del.—A booklet giving illustrations of the application of Hybnickel alloys for extreme service.

Hall-Will Inc., Erie, Pa.—A catalog of the new "Red-E-Hall" pipe threading machine, also a leaflet giving prices and specifications for the machine and accessories.

McCann-Harrison Corporation, Cleveland, Ohio.—Bulletins Nos. 81, 82 and 84—Bulletins describing indirect air heated ovens, unit air heaters and heating systems, and showing their application in industrial plants.

Combustion Engineering Corp., 43 Broad Street, New York, N. Y.—Catalog No. C-4—A new catalog describing the construction and operation of the Coxe traveling grate stoker.

Bacharach Industrial Instrument Co., Pittsburgh, Pa.—Bulletin No. 261—A bulletin describing steam engine indicators of the Maihak design.

National Machinery Co., Tiffin, Ohio.—A bulletin containing a reprint of an article by C. E. Harmon, entitled "Progress in Machine Forging."

Patterson Foundry & Machine Co., East Liverpool, Ohio.—Two new booklets on pebble mills.

Robinson Ventilating Co., Pittsburgh, Pa.—Two bulletins describing a new type of man-cooling fan.

International Nickel Co., 67 Wall Street, New York, N. Y.—Four new technical bulletins, giving data and applications of nickel products as follows: No. 201, giving properties and applications of nickel and nickel-chromium cast iron; No. 202, dealing with the improving of gray cast iron with nickel; No. 6, a bulletin entitled "Alloy Steel Reduces Die Block Costs"; No. 7, a bulletin entitled "Automotive Design and Automotive Steels."

General Electric Co., Schenectady, N. Y.—Several new bulletins as follows: GEA-38, a bulletin describing type CO-1820 direct current crane and hoist motors; GEA-71A, a bulletin on "900 Series" wound-rotor induction motors; GEA-90A, catalog of General Electric installations of automatic stations; GEA-367, bulletin of type QP-1 quick break knife switches; GEA-368, a bulletin of type LP-1 knife switches with round studs; GEA-394, bulletin describing induction motor-generator sets from 1 to 35 kw., 125 or 250 volts; GEA-424, catalog of distribution and small power transformers; GEA-432, a catalog of type CD direct current generators and exciters from 2 to 100 kw.; GEA-433, a bulletin describing type BD direct current generators and exciters from ½ to 2½ kw.; GEA-452, bulletin describing welding head and accessories for automatic arc welding apparatus; GEA-453, bulletin describing semi-automatic welding equipment; GEA-470, bulletin describing constant speed direct current vertical motors from ½ to 200 hp.

Crouse-Hinds Co., Syracuse, N. Y.—Folders Nos. 38 and 42—The first of these describes safety plugs and receptacles, interlocking switches and plugs, and safety hand lamps; the second describes vapor-proof condulets.

Hills-McCanna Co., 2025 Elston Ave., Chicago, Ill.—A folder on special alloys for special purposes and a second folder describing special pumps for chemicals.

DeLaval Steam Turbine Co., Trenton, N. J.—Folder E-1103—A description of installation of water pumps at Jackson, Mich.

Steacy-Schmidt Mfg. Co., York, Pa.—Folder calling attention to special machinery made by this company.

Hauck Mfg. Co., 126 Tenth St., Brooklyn, N. Y.—A folder describing the Venturi suction burning torch.

Buffalo Forge Co., Buffalo, N. Y.—Catalog No. 475—A catalog of Buffalo "Baby" conoidal fans in capacities from 78 to 6,850 cu.ft. per minute. Also a folder describing type FB variable and constant speed electric blowers.

H. H. Robertson Co., Pittsburgh, Pa.—A folder describing Robertson unit skylights.

Hill Clutch Machine & Foundry Co., Cleveland, Ohio.—Catalog No. 26—A new general catalog published in three sections covering shafting, bearings, clutches, pulleys, rope drives, agitators, gears, sprockets and speed changers.

The Milwaukee Electric Crane & Mfg. Corp., Milwaukee, Wis.—Catalog 100—A general catalog of electric traveling cranes and hoists.

The Dorr Company, 247 Park Ave., New York, N. Y.—A new bulletin on sanitary engineering, discussing the treatment of municipal sewage, the purification and softening of water supplies and the treatment of industrial waste waters.

The Norton Company, Worcester, Mass.—Several new catalogs as follows: Booklet describing the flexible grinding and polishing of metals; No. 1668, catalog of the Type L multipurpose universal grinding machine; No. 80, catalog of 6x32-in. hand and power traverse, Type A cylindrical grinding machines; No. 403, catalog 10-in. hand, power and special purpose, Type A cylindrical grinding machines; No. 405 catalog of 14-in. hand and power traverse, Type A cylindrical grinding machines.

The Flexible Steel Lacing Company, Chicago, Ill.—Folder describing belt fasteners for conveyor and other heavy belting.

Buffalo Foundry & Machine Co., Buffalo, N. Y.—Bulletin No. 216—A catalog of driers and evaporators for use in the manufacture of evaporated, condensed and powdered milk and other milk products.

The Alcumite Corp., Dayton, Ohio.—A new price sheet effective July 15, 1926, on sheets, rods and other products made from Alcumite.

Foxboro Company, Foxboro, Mass.—A folder describing the Foxboro liquid level gage.

Sullivan Machinery Co., Chicago, Ill.—Bulletins No. 71-I and No. 132—The first of these is a catalog describing the construction and use of Sullivan air lift pumping apparatus and the second, entitled "Handy Hoisting and Hauling," shows pictorially the use of Turbinair hoists, and other Sullivan equipment.

Driver-Harris Co., Harrison, N. J.—Catalog R-26—A new catalog of "Nichrome" and other alloys made by this company, giving specifications and applications.

State Mfg. Co., 4041 S. Kedzie Ave., Chicago, Ill.—A pamphlet describing the "Kocur" comparator set for determining the nickel in electroplating and electrotyping solutions.

Jenkins Bros., 80 White St., New York, N. Y.—Bulletin No. 107—A pamphlet describing Jenkins automatic equalizing stop and check valves for boilers.

Holly Pneumatic Systems, Inc., 100 East 45th St., New York, N. Y.—A new pamphlet describing dust collecting and recovery equipment.

Bailey Meter Co., Cleveland, Ohio—Bulletin No. 43—A catalog of steam and air flowmeters as guides to boiler operation.

Ohio Brass Co., Mansfield, Ohio—Catalog No. 20-O-B—General catalog of porcelain insulators, railway equipment and mining equipment.

Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.—Catalog No. 47-A—New catalog of industrial lighting equipment with instructions for planning lighting installations.

R. H. Beaumont Co., Philadelphia, Pa.—Bulletin No. 79—New catalog of skip hoists for handling bulk materials.

Patents Issued July 27 to Aug. 31, 1926

Paper, Pulp and Sugar

Process of Subjecting Wood and Similar Materials to a Preliminary Treatment for the Manufacture of Paper, Board, etc. Hubert Bräunlich, Freiwaldau, Czechoslovakia.—1,597,717.

Pulp Board and Method of Making Same. Daniel M. Sutherland, Jr., Trenton, N. J., assignor to The Agasote Millboard Co., Trenton, N. J.—1,598,260.

Art of Making Paper Pulp. Bertrand S. Summers, Port Huron, Mich.—1,597,841.

Apparatus for the Manufacture of Paper. Venning D. Simons, Chicago, Ill.—1,594,473.

Paper Pulp and Paper. Bertrand S. Summers, Port Huron, Mich.—1,597,840.

Paper. Harold R. Rafsky, now by judicial change of name Harold Robert Rafton, Lawrence, Mass.—1,595,416.

Method of Hydrating Cellulose Fibers in Concentrated Stock. Judson Albert De Cew, Mount Vernon, N. Y.—1,598,267.

Process and Apparatus for Producing a Reaction of Lime and Sucrose in the Manufacture of Sugar from Sugar Beets. Ralph W. Shafor, Edwin Morrison, Robert J. Brown, Laurence A. Stenger, and Alpheus R. Nees, Denver, Colo., assignors to The Great Western Sugar Company, Denver, Colo.—1,593,782.

Rubber and Synthetic Plastics

Process of Making Objects from Unvulcanized Rubber and Objects from vulcanized Rubber. Arnold Roedolf Frans van der Mark, Weltevreden, and Hein Kremer, Meloewoeng, Dutch East Indies.—1,597,170.

Process of Making a Rubberized Fiber Composition. Robley H. Morrison, Akron, Ohio, assignor to The Goodyear Tire & Rubber Company, Akron, Ohio.—1,595,048.

Method of Making a Rubberized Fiber Composition. Paul Beebe, Akron, Ohio, assignor to The Goodyear Tire & Rubber Company, Akron, Ohio.—1,595,374.

Apparatus for the Manufacture of Laminated Rubber Sheeting. William C. Stevens, Akron, Ohio, assignor to the Firestone Tire and Rubber Company, Akron, Ohio.—1,594,859.

Process for Devulcanizing Vulcanized Rubber and the Products Thereof. Cyrus Field Willard, San Diego, Calif.—1,598,470.

Method and Apparatus for Treating Rubber. Carmon A. Myers, Akron, Ohio, assignor to The Firestone Tire and Rubber Company, Akron, Ohio.—1,594,845.

Process for the Utilization of Rubber Bearing Plants and the Material Produced Thereby. Frank T. Lahey, Akron, Ohio.—1,597,807.

Vulcanizable Plastic Material. Frank T. Lahey, Akron, Ohio.—1,597,808.

Process of Uniting Two Rubber Surfaces. Leon B. Conant, Cambridge, Mass.—1,597,432.

Petroleum Refining

Apparatus for Cracking Oil. Gustav Egloff and Harry P. Benner, Chicago, Ill., assignors to Universal Oil Products Company, Chicago, Ill.—1,598,368.

Process for Cracking Oil. Paul Danckwardt, Denver, Colo.—1,594,666.

Process for Cracking Hydrocarbon Oil. Carbon P. Dubbs, Wilmette, Ill., assignor to The Universal Oil Products Company, Chicago, Ill.—1,594,093.

Process of Cracking Hydrocarbons. Eugene C. Herthel, Chicago, Ill., assignor to Sinclair Refining Company, Chicago, Ill.—1,598,136.

Apparatus for Conversion of Oils. Joseph H. Adams, Brooklyn, N. Y., assignor to The Texas Company, New York, N. Y.—1,595,332.

Process of Making Low-Boiling Hydrocarbons from Petroleum or Other Oils. Joseph Hidy James, Pittsburgh, Pa., assignor to Clarence P. Byrnes, trustee, Sewickley, Pa.—1,597,796.

Apparatus for Distilling and Cracking Crude Petroleum and Distillate. Carl M. Page, Chicago, Ill., assignor to George Fabyan, Geneva, Ill.—1,597,476.

Oil Coking Still. Jens O. Jenson, Baltimore, Md.—1,597,469.

Still and Method of Distilling. Percy Mather, London, England.—1,594,209.

Petroleum Still. Lemuel J. Husted, Los Angeles, Calif., assignor of one-half to F. L. Rounsevell, Los Angeles, Calif.—1,596,660.

Steam Distillation. Frank A. Howard, Westfield, N. J., and Edgar M. Clark, New York, N. Y., assignors to Standard Development Company.—1,594,957.

Distillation of Oil. Henry L. Doherty, New York, N. Y., assignor to Doherty Research Company, New York, N. Y.—1,597,674.

Crude Topping Plant. Clarence F. Hanson, Los Angeles, and Perry Vandervort, El Segundo, Calif.—1,597,375.

Art of Fractionally Distilling and Condensing Oils. Edgar M. Clark, New York, N. Y., and Frank A. Howard, Elizabeth, N. J., assignors to Standard Development Company.—1,595,642.

Manufacture of Lubricants. Morris C. Van Gundy and Howard Dimmig, Port Arthur, Tex., assignors to The Texas Company, New York, N. Y.—1,594,762.

Fuel Oil and Process of Making the Same. Edward A. Rudigier, Baltimore, Md., assignor to Standard Development Company.—1,597,292.

Method of Oxidizing Heavy Hydrocarbons. Joseph Hidy James, Pittsburgh, Pa., assignor to Clarence P. Byrnes, trustee, Sewickley, Pa.—1,597,797.

Process of Treating Hydrocarbon Gases. Julius E. Kobernik, Fullerton, Calif., assignor to Newton Process Manufacturing Co., Fullerton, Calif.—1,594,014.

Method of Treating Liquid Hydrocarbons. Joseph Hidy James, Pittsburgh, Pa., assignor to Clarence P. Byrnes, trustee, Sewickley, Pa.—1,597,798.

Apparatus for Treating Oil. Gustav Egloff and Harry P. Benner, Chicago, Ill., assignors to Universal Oil Products Company, Chicago, Ill.—1,595,179.

Oil-Treating Apparatus. Joseph W. Lewis, Philadelphia, Pa., assignor to The Atlantic Refining Company Philadelphia, Pa.—1,593,905.

Apparatus for Treating Oil. Nathan W. Shefferman, Washington, D. C., and Charles B. Mills, Baltimore, Md., assignors to the Jefferson Construction and Oil Treating Company, Washington, D. C.—1,597,628.

Process of Treating Hydrocarbon Gases and Product Thereof. Carleton Ellis, Montclair, N. J., assignor to Seth B. Hunt, trustee, Mount Kisco, N. Y.—1,594,823.

Removal of Sulphur and Sulphur Compounds from Hydrocarbon-Oil Distillates. Gerald L. Wendt, Chicago, Ill., assignor to Standard Oil Company, Whiting, Ind., and Chicago, Ill.—1,594,083.

Agent for the Purification of Iiquids by Adsorption. Paul W. Prutzman and Arnold D. Bennison, Los Angeles, Calif., assignors to General Petroleum Corporation of California, Los Angeles, Calif.—1,598,254.

Process for Breaking Water-in-Oil Emulsions. Melvin de Groote, St. Louis, Mo., assignor to Wm. S. Barnickel & Company, Webster Groves, Mo.—1,596,585.

Oil Dehydrator and Cleanser. Luther T. Arnold, Reward, Calif.—1,597,337.

Breaking of Oil-Water Emulsions. John Charles Walker, Eldorado, Kans., assignor to Doherty Research Company, New York, N. Y.—1,597,700.

Method of Dehydrating Oil Emulsions. Ralph A. Halloran, Berkeley, Calif., assignor to Standard Oil Company, San Francisco, Calif.—1,597,461.

Process for Treating Petroleum Emulsions. Melvin de Groote, St. Louis, and Wilbur C. Adams, University City, Mo., assignors to Wm. S. Barnickel & Company, Webster Groves, Mo.—1,595,455.

Prevention of Evaporation. Robert E. Wilson, Chicago, Ill., assignor to Standard Oil Company, Whiting, Ind., and Chicago, Ill.—1,596,385.

Method and Apparatus for Preventing Evaporation from Storage Tanks. Robert E. Wilson, Chicago, Ill., assignor to Standard Oil Company, Whiting, Ind., and Chicago, Ill.—1,597,399.

Process of Recovering Condensable Vapors from Gas Mixtures. George G. Oberfell, Tulsa, Okla., and George A. Burrell, Pittsburgh, Pa., assignors to Gasoline Recovery Corporation.—1,595,682.

Fuel Technology

Carbonization of Coal. Stewart Roy Illingworth, Brynfedwen, Radyr, Wales, assignor to The Illingworth Carbonization Company, Limited, Manchester, England.—1,593,697.

Process of Carbonization of Coal. Charles Hayes, Paris, France, assignor to Coal Carbonization Company.—1,595,934.

Low-Temperature Distillation Retort. Gabriel E. Rohmer, New York, N. Y., assignor, by direct and mesne assignments, to Arthur Vernon Abbott, Richmond, Va.—1,593,916.

Coke Oven. Marvin W. Ditto, Chicago, Ill., assignor, by mesne assignments, to Chicago Trust Company, trustee, Chicago, Ill.—1,596,408.

Gas Generator. Joseph Gibson, Los Angeles, Calif.—1,596,248.

Complete Gasification of Bituminous Fuel. Albert Breisig, Vienna, Austria.—1,598,473.

Gas-Making and Carbonizing Apparatus and Process. William W. Odell, Minneapolis, Minn.—1,598,217.

Apparatus for Extracting Gas from Bituminous Materials. Emanuel W. Hartman, Miami, Fla., assignor to Hartman Interests Inc., Los Angeles, Calif.—1,595,301.

Briquette and Process of Making the Same. John P. Delzeit, Tamaqua, Pa., assignor to The Lehigh Coal and Navigation Company, Philadelphia, Pa.—1,596,239.

Briquette and Process of Making the Same. Srinivas Ram Wagel, New York, N. Y., assignor to The Lehigh Coal and Navigation Company.—1,596,218.

Binder for Coal Briquettes and the Like. Wladislaus Rakowski, Philadelphia, Pa.—1,596,624.

Method of Making Coal Briquettes of Anthracitic Quality from Immature Carboniferous Substances. Jacques Beaudequin, Paris, France.—1,597,570.

Tar-Distillation Apparatus. Heinrich Koppers, Essen-Ruhr, Germany, assignor to The Koppers Development Corporation, Pittsburgh, Pa.—1,596,050.

Method of Removing Tar from the vapors Arising from the Carbonization of Wood. Emile Augustin Barbet, Paris, France.—1,598,547.

Apparatus for Treating Gas Liquor. Le Roy Wilbur Heffner, East Norristown Township, Montgomery County, and William Tiddy, Jeffersonville, Pa., assignors to Rainey-Wood Process Corporation, New York, N. Y.—1,595,602.

Organic Processes

Azo Dyes Containing a Diphenylurea Nucleus. Henry Wenker, Hamburg, N. Y., assignor to National Aniline & Chemical Co., Inc., New York, N, Y.—1,594,805.

Mono Azo Dyes. Walter Duisberg, Winfried Hentrich, and Ludwig Zeh, Wiesdorf-on-the-Rhine, Germany, assignors to Grasselli Dyestuff Corporation, New York, N. Y.—1,595,178.

Azo Coloring Matter Dyeing Wool Fast to Milling and Process for Obtaining the Same. James Baddiley, James Hill, and Albert Riley, Manchester, England, assignors to British Dyestuffs Corporation Limited, Manchester, England.—1,598,109.

Disazo Dyestuffs Containing a Diphenylurea Nucleus. Leon W. Geller, Hamburg, N. Y., assignor to National Aniline & Chemical Co. Inc., New York, N. Y.—1,594,828.

Azo Dyestuffs and Intermediates and Process for Making Same. Eric Berkeley Higgins, London, England.—1,597,791.

Oxazine Dyestuff of the Anthraquinone Series. Robert Emanuel Schmidt and Berthold Stein, Elberfeld, Germany, assignors to Grasselli Dyestuff Corporation, New York, N. Y.—1,596,460.

Halogenated Vat Dyestuffs of the Anthraquinone Series and Process of Making Same. Alfred Holl, Offenbach-on-the-Main, Germany, assignor to I. G. Farbenindustrie Aktienegesellschaft, Frankfort, Germany.—1,595,549.

2,4-Dihydroxydiphenylethane and process of making it. Emil Klarmann, Jersey City, N. J., assignor to Lehn & Fink, Inc., New York, N. Y.—1,596,613.

Making 2-Hydroxy-Naphthalene-6-Carboxylic Acid. Franz Andre, Offenbach-on-the-Main, Germany, assignor to Grasselli Dyestuffs Corporation, New York, N. Y.—1,593,816.

Process for the Production of 5-Amino-3-Chloro-4-Hydroxybenzene-1-Arsonic Acid. Louis Benda, Mainkur, near Frankfort-on-the-Main, and Werner Schmidt, Fechenheim, near Frankfort-on-the-Main, Germany, assignors to I. G. Farbenindustrie Aktiengesellschaft.—1,595,498.

Di-Acylacetyl-Diamino Compounds of the Diaryl Series and Process of Making Same. Arthur Zitscher and Robert Schmitt, Offenbach-on-the-Main, Germany, assignors to I. G. Farbenindustrie Aktiengesellschaft, Frankfort-on-the-Main, Germany.—1,594,964.

Anthracene-2.1-Thioindoxyl and Process of Making the Same. Robert Stocker, Basel, and Jacob Müller, Munchenstein,

near Basel, Switzerland, assignors to Society of Chemical Industry in Basle, Basel, Switzerland.—1,598,167.

Manufacture of Sulphocyano Derivatives. Oskar Spengler, Dessau, Anheim, and Werner Müller, Leipzig, Germany, assignors to Actien Gesellschaft für Anilin Fabrikation, Berlin, Germany.—1,594,697.

Dyestuffs Containing Chromium and Process of Making the Same. Fritz Straub, Basel, Switzerland, assignor to Society of Chemical Industry in Basle, Basel, Switzerland.—1,598,169.

Sulphur Black and Similar Sulphur Dyes. Morris Paley, Charleston, W. Va.—1,598,303.

Anthracene Dye and a Process of Making. Ivan Gubelmann, South Milwaukee, Wis., assignor to The Newport Company, Milwaukee, Wis.—1,596,528.

Production of Alpha-Nitronaphthalene-Beta-Sulphonic Acids. Ralph A. Nelson, Buffalo, N. Y., assignor to National Aniline & Chemical Co., Inc., Buffalo, N. Y.—1,594,547.

Process for the Separation of Ortho-Chlorotoluene and Parachlorotoluene. André Raoul Wahl, Enghien, France, assignor of one-half to Société Anonyme des Matières Colorantes et Produits Chimiques de Saint Denis, Paris, France.—1,596,325.

Flaked Beta Naphthol and Process of Making Same. Nathan E. Van Stone and Charles E. Deeds, Chicago, Ill., assignors to The Sherwin-Williams Company, Cleveland, Ohio.—1,594,390.

Process of Making Dihydroxy Carbon Compounds. Harry Essex and Alger L. Ward, Wilmington, Del., assignors to E. I. du Pont de Nemours & Company, Wilmington, Del.—1,594,608.

Process for Making Calcium Cyanogen Compounds and the Product Thereof. Robert W. Poindexter, Jr., Los Angeles, Calif., assignor to California Cyanide Company, Incorporated, New York, N. Y.—1,596,119.

Process of Making Aldols. Clarence J. Herrly, Niagara Falls, N. Y., assignor to Carbide and Carbon Chemicals Corporation.—1,598,522.

Nitrated Ester. Charles E. Burke and Richard L. Kramer, Wilmington, Del., assignors to E. I. du Pont de Nemours & Company, Wilmington, Del.—1,598,474.

Manufacture of Phosphoric Esters of Polyhydric Alcohols. Paul Emile Goissedet and André Louis Husson, Lyon, France, assignors to Societe Chimique des Usines du Rhone, Paris, France.—1,598,370.

Process and Apparatus for Manufacture of Carbon-Black Unsaturated Gases and Hydrogen. Jay J. Jakowsky, Los Angeles, Calif.—1,597,277.

Stabilizer for Nitrated Organic Compounds. Walter A. Patrick, Baltimore, Md., assignor, by mesne assignments, to The Silica Gel Corporation, Baltimore, Md.—1,596,622.

Use of Hydrosulphites or Sulfoxylates in the Removal of Dyes from Textile Fibers. Charles S. Hollander, Philadelphia, Pa., assignor to Rohm & Haas Company.—1,594,670.

Method of Manufacture of Artificial Silk. Charles C. Jessen, Wilmington, Del., assignor to Atlas Powder Company, Wilmington, Del.—1,597,684.

Manufacture of Artificial Products from Viscose. Darcy van der Want and Martinus Pétrus Antonius Bouman, Arnhem, Netherlands, assignors to Naamloose Vennootschap Nederlandsche Kunstzijdefabriek, Arnhem, Netherlands.—1,596,906.

Process of Making Halohydrins. Harry Essex and Alger L. Ward, Wilmington, Del., assignors to E. I. du Pont de Nemours & Company, Wilmington, Del.—1,594,879.

Refining Alcohol. Emile Augustin Barbet, Paris, France.—1,598,548.

Manufacture of Phenols. William J. Hale, Midland, Mich., assignor to The Dow Chemical Company, Midland, Mich.—1,595,299.

Manufacture of Carbon Black. Walter O. Snelling, Allentown, Pa.—1,596,070.

Process of Making Edible Alkali Caseinate. Harper F. Zoller, Detroit, Mich.—1,598,334.

Purification of Lactic Acid. James W. Lawrie, Wilmington, Del., assignor to E. I. du Pont de Nemours & Company, Wilmington, Del.—1,594,843.

Method of Extracting Turpentine, Fine Oil, and Rosin. Earl P. Stevenson, Cambridge, Mass., assignor to Arthur D. Little, Inc., Cambridge, Mass.—1,597,215.

Refining Aldehyde Resins. Willy O. Herrmann and Hans Deutsch, Munich, Germany, assignors to Consortium für Elektrochemische Industrie G. m. b. H., Munich, Bavaria.—1,596,971.

Resinous Bodies Derived from Acetaldehyde and Process of Making the Same. Leo H. Bakeland, Yonkers, and August H. Gotthelf, Hastings-upon-Hudson, N. Y., assignors, by mesne assignments, to Bakelite Corporation, New York, N. Y.—1,598,546.

Distillation of Resin. Frank E. Greenwood, New Rochelle, N. Y., assignor to Pine Waste Products, Inc., New York, N. Y.—1,593,656.

Inorganic Processes

Process for Producing Sulphur Dioxide and Apparatus Therefor. Hans O. C. Isenberg, Garden City, N. Y., assignor to General Chemical Company, New York, N. Y.—1,595,196.

Manufacture of Oxide Pigments. John R. MacMillan, La Salle, N. Y., assignor, by mesne assignments, to Niagara Pigment Corporation, Niagara Falls, N. Y.—1,596,363.

Process of Producing Stannous Chloride. William T. Little, Elizabeth, N. J., assignor to Metal & Thermit Corporation, Carteret, N. J.—1,597,653.

Method of Producing Hydrogen and Phosphoric Acid. Frans Georg Liljenroth, Stocksund, Sweden, assignor to Phosphorus-Hydrogen Company.—1,594,372.

Removal of Calcium and Magnesium from Rock-Salt Brine. Francis Arthur Freeth, Sandiway, and Leslie Alexander Munroe, Northwich, England, assignors to Solvay Process Company, Solvay, N. Y.—1,597,370.

Method of Making Zinc Sulphide. Frank G. Breyer, Palmerton, and Clayton W. Farber, Bowmanstown, Pa., assignors to The New Jersey Zinc Company, New York, N. Y.—1,594,001.

Process for the Simultaneous Production of Potassium Phosphate and Phosphoric Acid. William H. Ross, Russell M. Jones, and Arnon L. Mehring, Washington, D. C., dedicated, by mesne assignments, to the Citizens of the United States of America.—1,598,259.

Process for the Preparation of a Solution of Cyanamide from Commercial Calcium Cyanamide. Joseph Beslauer, Geneva, Switzerland, assignor to Compagnie de l'Azote et des Fertilisants S. A., Geneva, Switzerland.—1,595,754.

Apparatus for Cement Manufacture and Process for Operating the Same. Edmund George Weeks, Northumberland, England, assignor to the Firm Merz & McLellan, Westminster, London, England.—1,596,956.

Cement and Process of Making Same. Hans Kühl, Berlin-Lichterfelde, Germany, assignor to Albert T. Otto & Sons, New York, N. Y.—1,594,178.

Process of Producing Barium Chloride. Anton Jahl, Hamburg-Horn, Germany, assignor to the Firm J. Michael & Co., Berlin, Germany.—1,593,902.

Method of Separating Cobalt from Nickel. William J. Harshaw, Shaker Heights Village, Ohio, assignor to The Harshaw, Fuller & Goodwin Company, Cleveland, Ohio.—1,596,253.

Process of Manufacturing Arsenates. John D. Jenkins and Eugene F. Berger, Milwaukee, Wis., assignors to Pittsburgh Plate Glass Company.—1,596,662.

Process for Treating Arsenic and Antimony Compounds and Minerals. Melville F. Coolbaugh and John Burns Read, Golden, Colo., assignors to The Complex Ores Recoveries Company, Denver, Colo.—1,597,018.

Method of Concentrating and Purification of Phosphoric Acid. Harry E. La Bour, Homewood, Ill.—1,597,984.

System of Concentrating Sulphuric Acid. Arthur A. Vineyard, Woodriver, Ill.—1,596,907.

Process for the Continuous Separation of Sulphur from Sulphur Solutions. Eberhard Legeler, Permnitz, Westhavelland, Germany.—1,594,783.

Method of Removing Sulphureted Hydrogen from Gases. Wilhelm Gludd, Dortmund, Germany.—1,597,964.

Production of Ammonia by Synthesis and Apparatus Therefor. Hans Harter, Wurzburg, Germany.—1,593,657.

Method of Forming Nitrogen-Hydrogen Mixtures. John Collins Clancy, Providence, R. I., assignor to The Nitrogen Corporation, Providence, R. I.—1,594,815.

Bleaching Process. William D. Gregor, Wesley M. Osborne, and Alex J. Kemzura, Newton Falls, N. Y.—1,597,880.

Process of Making Glass. Charles E. Parsons, New York, N. Y., assignor to Metal Research Corporation, New York, N. Y.—1,595,358.

Process of Electrolytic Decomposition of Chlorides. Ernst Schlumberger, Berlin-Lichterfelde-Ost, Germany, assignor of three-fourths to the Firm Koholyt Aktiengesellschaft, Berlin, Germany.—1,598,018.

Electrodeposition of Tin. Horace Russell McIlhenney, Rahway, N. J., assignor to Vulcan Detinning Company, Sewaren, N. J.—1,598,295.

Electrolytic Cell. Alexander T. Stuart, Detroit, Mich.—1,597,552.

Process of Producing Alumina, Alkali, and Dicalcium Silicate. Alfred H. Cowles, Sewaren, N. J., assignor to The Electric Smelting & Aluminum Company, Cleveland, Ohio.—1,591,364.

Process of Recovering Lithium Salts From Phosphate Minerals Containing Lithium. Hans Weidmann, Frankfort-on-the-Main, Germany, assignor to Allied Process Corporation, New York, N. Y.—1,591,196.

Production of Oxides and other Compounds of Zinc, Lead, and the Like. Leland E. Wemple, St. Louis, Mo., assignor to American Zinc, Lead & Smelting Company, Boston, Mass.—1,591,253.

Method and Means for Deactivation of Water. Frank N. Speller, Pittsburgh, Pa.—1,592,647.

Basic Chromic Salts and Process of Making Same. Heinrich Rössner and Ernst Runne, Hochst-on-the-Main, Germany, assignors to Grasselli Dyestuff Corporation, New York, N. Y.—1,592,961.

Process for the Reduction of Neutral and Acid Metal-Salt Solution. Hans Bardt, Santiago, Chile.—1,592,173.

Process of Making Arsenates of Manganese. Wellington Lee Tanner, Cleveland, Ohio, assignor to The Grasselli Chemical Company, Cleveland, Ohio.—1,591,795.

Production of Carbon Monoxide. Johann Emil Leonarz, Tacubaya, Mexico.—1,592,860.

Method of Recovering Potassium Chloride from Brine. Joseph L. Silsbee, Salt Lake City, Utah.—1,593,038.

Chemical Engineering Equipment

Gyratory Cone Crusher. Edgar B. Symons, Los Angeles, Calif., assignor to Symons Brothers Company, Milwaukee, Wis.—1,592,313.

Crusher. Ray C. Newhouse, Wauwatosa, Wis., assignor to Allis-Chalmers Manufacturing Company, Milwaukee, Wis.—1,591,942.

Machine for Pulverizing or Grinding Coal and Other Materials. Percy Walter Griffin, Enfield England, assignor of one-half to Vickers Limited, Westminster, London, England.—1,591,758.

Roller Mill. Walter Merritt Cook, Ludlow, Vt., assignor by mesne assignments, to The Raymond Brothers Impact Pulverizer Company.—1,592,135.

Ball Mill. Povl T. Lindhard, Brooklyn, N. Y., assignor to F. L. Smidth & Co., New York, N. Y.—1,591,916.

Pulverizing Machine. Edmond Charton and Pierre Maurice Mongereau, Paris, France.—1,591,283.

Heat Exchanger. Gregory D. Mantle, Pittsburgh, Pa., assignor to The Calorizing Company, Pittsburgh, Pa.—1,593,539.

Heat Exchanger. Joseph Price, New York, N. Y., assignor to The Griscom-Russell Company, New York, N. Y.—1,592,538.

Dehydrating Plant. Joshua M. Younger, San Francisco, Calif.—1,592,318.

Drying Apparatus. Rolf Thelen, Madison, Wis., dedicated, by mesne assignments, to the Citizens of the United States of America.—1,591,577.

Dehydrator. Joshua M. Younger, Oakland, Calif.—1,593,378.

Tunnel Kiln. William E. Wilson, Mason City, Iowa, and Henry G. Lykken, Minneapolis, Minn.—1,591,599.

Rotary Drying Machine. James Arthur Reavell, London, England.—1,591,053.

Bleaching Apparatus. Robert B. Wolf, New York, N. Y.—1,591,070.

Gas-Purification Process. Frederick W. Sperr, Jr., Pittsburgh, Pa., assigner to The Koppers Company, Pittsburgh, Pa.—1,592,648.

Gas-Purification Apparatus. Frederick W. Sperr, Jr., Pittsburgh, Pa., assignor to The Koppers Company, Pittsburgh, Pa.—1,592,649.

Art of Humidification. Albert J. Loepsinger, Providence, R. I., assignor to General Fire Extinguisher Company, Providence, R. I.—1,592,982.

Evaporation of Brines. Russell W. Mumford, Trona, Calif., assignor to American Trona Corporation, New York, N. Y.—1,591,725.

Method of Sublimation. Chauncey A. Lyford, East Aurora, N. Y., assignor to National Aniline & Chemical Co., Inc., New York, N. Y.—1,591,715.

Apparatus for Making Water Gas. Ralph R. McDonnell and Joseph S. McDonnell, Chicago, Ill.—1,592,464.

Acid-Proof Drum and Method of Making Same. Richard T. Griffiths, Akron, Ohio, assignor to The Miller Rubber Company, Akron, Ohio.—1,591,373.

News of the Industry

Treasury Department Outlines Its Alcohol Policy

Dr. J. M. Doran head of the Industrial Alcohol and Chemical Division of the Treasury Department has prepared a statement in which the policy of the department is outlined relative to the control of the manufacture and distribution of industrial alcohol. The main objects sought are to obtain proper denaturants for alcohol so as to render it less potable for human consumption and more efficient for industrial purposes and at the same time to hold down to a minimum the use of toxic ingredients as denaturants.

It is the department's view, according to the statement, that a weak policy of denaturation would break down industry by making easy openings for illegal operations. The department further holds that such a policy would lessen the protection to the public which it feels must be considered in all denaturing formulas created. Chemists, working under Dr. Doran's guidance and in co-operation with industries employing alcohol have drawn up some 60 specialized formulas, the statement said.

Many factors bearing on the problem require extended scientific investigation. For example, the denaturing substances employed must be of such a nature as to remain with the alcohol under a most severe manipulative treatment. The substance must be non-corrosive, and, in the quantity used non-toxic, and the compounded formula must be suitable for lawful industrial use. There is a misapprehension in the public mind as to the underlying reasons for the use of denaturing grade of methanol. There is no doubt in the mind of any well-informed chemist that the long standing use of methanol is based on sound scientific principles.

The current investigational work by the department has developed the suitability of certain complex oil compounds of an odorous and disagreeable nature but of themselves non-toxic which, when used with a minimum quantity of methanol, will not only remain with the alcohol under manipulation treatment but will so mark the concoction in which it may be employed by a criminal that nobody will consume the same unknowingly but only by a deliberate and willful act. The protection and encouragement of lawful industrial alcohol use, coupled with maximum protection of the public, is the aim and object of the department's scientific work on this subject. The present development of chemical industry in the United States and the fact that other countries are adopting some of our special methods is evidence of the constructive course pursued by the department.

The present system of denaturation meets with the approval of those industries whose continued welfare is essential to the public good.

Opposition to Carbon Black Production in Louisiana

The Texas State Railroad Commission has entered the controversy which is being waged regarding the production of carbon black from gas taken from gas wells on the Louisiana side of the Waskom field. The commission has urged the Conservation Department of Louisiana to withdraw the permits granted for this activity so as to save the gas field. Many cities and towns in Texas secure their natural gas supply from this source. It is held that if the making of carbon black from gas from this field is not stopped, the supply of gas at Marshall, Tyler, Carthage, Beaumont and Port Arthur, and neighboring sections, will be seriously affected. The Texas State Legislature has refused to make lawful the use of gas for carbon black manufacture along the Louisiana line.

Chemical Exhibition to Be Held in England

An exhibition is being organized on behalf of the Manchester section of the Society of Chemical Industries, supported by the Coke Oven Manager's Association, the Institute of Gas Engineers, and kindred organizations, to be held in Manchester, England, November 16-27, 1926. The scope of the exhibition will embrace all coal tar products, dyes and colors, fuels and heavy oils, industrial and fine chemicals, instruments, plants for purification, carbonization, and treatment of coal, and chemical engineering plants of all kinds. American manufacturers having offices or representation in England are eligible to participate.

Industrial Alcohol Plant Under Construction in Canada

The Quebec Industrial Alcohol Co. has under construction at Sorel, Quebec, a large plant for the manufacture of industrial alcohol. Molasses, the raw material, will be pumped directly from tank steamers to five steel tanks with a capacity of 3,600,000 gal. The distillation equipment consists of a continuous still which will produce 5,000 gal. of 95 per cent alcohol per day. Consumption in Canada of industrial alcohol is steadily increasing.

Renewal of Nitrate Producers' Charter in Doubt

Added to its other troubles the Chile Nitrate Producers' Association is going to have trouble getting its charter renewed when it expires next year, according to reports from the southern republic. The slump in nitrate shares; the government's lack of sympathy with the industry and the progress being made by air-fixation and coke-oven producers has the Chilean industry in dangerous straits. In fact, the situation is such that concern is beginning to be felt among American consumers. This is particularly true in the South where nitrate of soda is relied upon to give the quick stimulation necessary to the early maturing of the crop, before the boll weevil infestation reaches its maximum.

In the past the American farmer has had some harsh things to say about being forced to pay sixty per cent of the expenses of the Chilean government, but there is no desire to see the Chilean industry put out of business. The hope is that the competition will be sufficiently keen to cause the removal of the export tax and to force the adoption of all possible economies. In this way the very much desired material would be available at a much lower price. The hint that the synthetic industry is crippling the nitrate producers seriously has emphasized the fact that many farmers are opposed strongly to the use of synthetic nitrogen.

The suggestion has been made to the Chilean producers that they work to the end of laying down nitrate of soda in this market at the actual cost of production and delivery, plus a fair profit, and then put a part of the profit in a pool with the synthetic producers for the purpose of extending the use of nitrogen fertilizers. If all the nitrogen were used that the land in this country ought to have, it is argued, there would be a market for the entire production.

Paper Company Will Maintain Research Laboratory

Recognizing the advantages of more specialized laboratory research work, the Abitibi Power and Paper Co. of Canada, has decided to separate entirely its research laboratory from the operating organization. In order to facilitate this work a new company has been formed, called the Abitibi Research Corporation, of which R. W. Hovey has been made president and manager.

Foreign Chemists Honored at A.C.S. Meeting

Honorary Membership in The Society Conferred on Chemists from Many Countries

Celebrating its golden jubilee in the city of its birth, the American Chemical Society held its 72nd meeting in Philadelphia, Sept. 6-11, with a registered attendance of 2500. The 50th anniversary of the founding of the Society coincides with the 150th of American independence and the 152nd of the discovery of oxygen by Priestley. The general sessions were marked by two conspicuous events: A pilgrimage to the grave and home of Joseph Priestley at Northumberland, Pa., and the conferring of honorary membership in the society on a number of eminent foreign chemists.

The pilgrimage to the Priestley shrine was marked by appropriate ceremonies. At the cemetery each visitor laid a flower on the grave and at the house there was a brief program followed by inspection of Priestley's relics on exhibition in the museum. Col. William H. Walker, representing the G. G. Pond Memorial Association, told of the purchase of the Priestley mansion by the alumni of Pennsylvania State College, former students of Dean Pond. S. A. Goldschmidt and A. A. Breneman, who attended a meeting at Priestley's home in 1874, the centennial of the discovery of oxygen, gave reminiscences of that meeting which resulted two years later in the formal organization of the American Chemical Society. Dr. C. A. Browne gave a historical sketch of Priestley's life and work in Northumberland and discussed the relics on exhibition in the museum.

At the general sessions in Philadelphia Prince P. Ginori Conti of Italy spoke on "The Development of Chemical Industry in Italy." Prince Conti is known for his production of boric acid and borax from fumaroles, as well as the development of power from subterranean steam. Lacking coal and oil in its natural resources, but with an abundance of hydroelectric power, Italy has developed chemical and electrochemical industries on an important scale. Synthetic ammonia, using electrolytic hydrogen only, is under production at a rate that will soon reach 150 tons per day. Potash and alumina are being recovered from leucite, and synthetic textile fibers are produced on a large scale, giving Italy second place among the countries of the world. Irenee du Pont, looking beyond the development of the American dye industry spoke on "The Dyestuff Industry, Forerunner of What?" Among other things he foresaw the synthesis of many important organic products such as starches and sugars, and the storage of energy from the sun's heat. In general he regarded the dye industry as "the forerunner of the chemistry of human well-being." Paul Sabatier, famed for his discoveries in catalysis, spoke in French on the influence of Berthelot on modern chemistry.

"Flames of Atomic Hydrogen" was the subject of a lecture by Dr. Irving Langmuir in which he reviewed his researches leading to the development of arc welding in hydrogen, described in *Chem. & Met.*, April and May, 1926. A complementary lecture on "Chemical Reaction of Atomic Hydrogen" was given by Dr. Hugh S. Taylor. In lighter vein Dr. Ernest Cohen of the University of Utrecht entertained the audience with a lecture on "Caricature in Science" illustrated by early caricatures of the life and work of eminent chemists.

The Priestley medal was awarded to Edgar F. Smith. Honorary membership in the society was conferred upon a group of chemists representing England, Scotland, France, Italy, Holland, Czechoslovakia, Switzerland, Japan, Belgium, Canada and the United States. Present in person on this occasion were Sir James C. Irvine, University of St. Andrews, Scotland; Ernst Cohen, University of Utrecht, Holland; Paul Sabatier, Toulouse, France; Frederic Swarts, University of Ghent, Belgium; W. Lash Miller, University of Toronto; Ira Remsen, Johns-Hopkins University; Theodore W. Richards, Harvard University and Edgar F. Smith, University of Pennsylvania. Others who were similraly honored, though not present, were Charles Moureau, College of France; Bohuslav Brauner, University of Prague; Guiseppe Bruni, University of Milan, Frederick G. Donnan, University of London and Joji Sakurai, University of Japan.

The technical sessions of interest to readers of *Chem. & Met.* are reported elsewhere in this issue.

Nitrate of Lime Production in Germany Increased

A report to the Department of Commerce says that the I. G. Farbenindustrie's nitrate of lime plants at Hochst on the Main have been expanded to permit an increase in the production from 1,500 to 10,000 metric tons monthly. It is reported that new and very moderate laboratories have been built. Large storage sheds and new light railway lines are also reported to have been constructed. Construction was undertaken at high speed on the day and night shift system as it is stated that at times the Ludwigshafen-Oppau plants had difficulty in covering the demand for fertilizers.

Permutit Co. Loses Appeal in Water Softening Suit

Long drawn out Canadian litigation in the case of George Borrowman vs. Permutit Co. to determine priority in the invention of softening water with greensand was ended on July 10 when the Privy Council in London dismissed the case in favor of the plaintiff and taxed costs to the defendant. Applications for patent on this invention were made in Canada by both Borrowman and Spencer, the latter assigning to the Permutit Co. of New York. The Canadian Patent Office declared a conflict and the matter was adjudicated in the Exchequer Court in favor of Spencer. Borrowman then appealed to the Supreme Court of Canada and obtained judgment in his favor, whereupon the Permutit Co. appealed to the Privy Council at London, with the result indicated above.

Development of Ceramic Industry in Canada

Extensive development in the ceramic industry in Canada is indicated by a statement by the Canadian Pacific Railway that the efforts of the department of ceramics at Saskatchewan University are taking shape in the stablishment at Estevan, of the International Clay Products, Limited, which is planning on production on a large scale and which anticipates a wide demand for its products on the Prairies. The company owns extensive clay deposits at Willows and Knollys in southern Saskatchewan, and experiments at the University have shown these to be equal to the best English and Austrian deposits. The plant has five kilns and is capable of producing 34,000 bricks at one burning. When the plant is completely organized, it is stated that it will be in a position to produce brick of all kinds as well as sanitary ware, electric porcelain, terra cotta floor and wall tile, and clay vessels of various kinds.

Pumping of Potash Studied by Bureau of Mines

A thorough study of the possibility of pumping potash in solution through pipe lines is to be made by the Bureau of Mines. One of the arguments used against the expenditure of public funds for potash was that the salts could not compete east of the Mississippi river largely because of the freight rate. In the hope that the transportation can be accomplished cheaper by pipe line, the Bureau will study the relative solubility of the different salts; the degree of saturation that can be pumped through pipes; the bearing velocity that will have to be maintained and the effect of the solution on pipe. If it is found that corrosion is caused methods of preserving the pipe against chemical action will be studied.

C. W. S. Investigates Control of Marine Pests

That the teredo and other marine borers may have cycles of activity is one of the assumptions reached by the Chemical Warfare Service to explain its greatly extended activities. The fact that these borers have appeared in Pacific waters, where they were unknown before, may be explained, it is declared, by the increased salinity of the water, due to the decreased volume of discharge from fresh water streams caused by the deficiency of rainfall in recent years.

The Chemical Warfare Service has found eleven chemicals which, when added to creosote, are effective in the control of marine pests. Some of the most desirable poisons for use in this work do not have the requisite degree of solubility. To be effective in the treatment of piling or other wood intended for use under water the poison must be slightly soluble. This eliminates substances not soluble in sea water and those which leach too quickly.

A report on this subject has been made to the Smithsonian Institution.

News from Washington

By Paul Wooton

WASHINGTON CORRESPONDENT OF *Chem. & Met.*

FOR MORE than a year the production of chemicals in the United States has exceeded that of any other country. With the idea of maintaining that proud position and for the purpose of giving greater stability to the industry, the Secretary of Commerce, at the request of various chemical organizations, will invite the principal executives of all chemical manufacturing concerns to assemble in Washington November 7.

The principal purpose of the gathering is to give impetus to "the will to export." The feeling at the Department of Comerce is that the chemical industry is too dependent on the domestic market. If the volume of exports could be doubled it would be an important safeguard against possible recession of domestic demand. Our exports would have to be quadrupled before they would bear the same relation to production as do the exports of the principal other chemical manufacturing countries. It is with the hope of removing this element of weakness that the Department desires to imbue the industry with the zeal necessary to go forth and annex more of the world trade.

The chemical industry in the United States was on the defensive so long that all but the largest manufacturers developed a sort of inferiority complex. They fear they will not be able to compete abroad. The Department thinks any firm that can satisfy the domestic trade has developed a degree of excellence which will appeal abroad. Moreover, the unit costs have been reduced in this country to the point where they compare favorably with those of any other country. Furthermore, unit costs abroad have been mounting steadily and promise to go higher. It is believed that all that is needed to double exports is to encourage many firms to assume the offensive and enter overseas markets. The Department, anticipating the success of the forthcoming meeting and an increased effort to secure foreign trade, is strengthening its chemical staff abroad.

By inviting the executives of the companies the Department is profiting from the experience at other gatherings. Usually members of the technical staff predominate at chemical meetings. Regardless of the weight that may be given their opinions on technical matters, they generally are not in a position to put into effect an innovation in business policy. For that reason it is hoped to deal with those who are in a position to carry out any suggestion made at the conference which may appeal to them.

At the meeting the Department will try to demonstrate that it is in a position to make easy the entry into the export field. Its tariff specialist will show that he is in a position at all times to give full information as to duties and of prospective changes in the rates. Another specialist will explain the service he can render in connection with financial questions that may arise. The commercial law specialist will give examples of the service he can render in acquainting prospective exporters with the essential details of the laws of countries to which shipments are to be made. The commercial intelligence chief will explain how credit ratings are furnished and how responsible agents can be secured. Another chief will show how full transportation information is available for the asking.

In the opinion of John I. Tierney, the Washington representative of the Manufacturing Chemists Association this meeting is destined to be one of the most momentus in the history of the industry. The suggestion for such a gathering came from the Department's chemical advisory committee last May. It had the immediate approval of Secretary Hoover, of Dr. Julius Klein, director of the Bureau of Foreign and Domestic Commerce, and of C. C. Concannon, the chief of the chemical division. Since the recommendation was made the industry has been sounded out and found to be thoroughly receptive to the idea.

Personnel of Advisory Committee

The members of the advisory committee are anxious to have suggestions as to matters which should be discussed at this meeting and are anxious to have the names of all executives to whom invitations to attend should be extended. The committee is composed of the following members: Cressey A. Morrison, Union Carbide and Carbon Company, New York; Dr. C. T. Herty, President of the Synthetic Organic Chemical Manufacturers Association, New York City; Dr. Leo Baekeland, Bakelite Products Co., New York; Dr. A. S. Burdick, Abbott Laboratory, Chicago; Dr. H. E. Howe, Editor, *Industrial and Engineering Chemistry*, Washington, D. C.; Dr. Henry Howard, Grasselli Chemical Company, Cleveland; G. Ober, Ober Fertilizer Company, Baltimore; E. T. Trigg, Lucas Paint Company, Philadelphia; and S. W. Wilder, Merrimac Chemical Co., Boston.

Major General Edgar Jadwin, the Chief of Engineers, and Senator Deneen, of Illinois, the chairman of the joint Congressional committee on Muscle Shoals, recently visited the government's big development on the Tennessee River. They inspected the dam, the power house, the electrical installation, the nitrate plants and the site of the proposed Dam No. 3. Only a portion of the water is being used for power development, General Jadwin reports. The power needs of the Alabama Power Company have declined steadily from a daily maximum of 2,218,000 attained in June.

A number of discoveries of thoria have been reported recently to the Bureau of Mines. In most instances the discoverer is of the opinion that his find is one of value. In these cases the Bureau has to advise that no monagite sand found in this country thus far is rich enough to compete with the sands being worked in India and Brazil. The Indian sand carries about 9 per cent of ThO_2, while the Brazilian products runs as high as 6½ per cent.

The lean American sand cannot begin to compete with the imported commodity. Moreover the use of monozite sand is shrinking. Two companies, one in New Jersey and the other in Chicago, are making thorium nitrate for use in incandescent mantles, but the space in their plants formerly given over to this work gradually is being devoted to other activities.

No small amount of research is being done in the hope of finding new uses for thoria. Small amounts are being used in radio tubes, in electric lamp filaments and in sparking alloys, such as those used in certain types of cigar lighters. Formerly there was a substantial demand for mesotherium for use in luminous points, but cheaper radium from Africa has taken away that market.

Potash Purchases Increase

Quite unexpectedly domestic purchases of potash in Germany increased materially during the first half of 1926. It had been anticipated that they would be less than during the first half of 1925. This is thought to indicate an increase in the buying power of the farmers, although it is known that more liberal credits were extended.

During the first six month of 1926 there was a slight increase in exports of potash salts. Apparently the depreciation of the franc has not stimulated foreign shipments to any great extent.

Reports that serious friction has developed between the French and German producers over the accord of May, 1926, are denied on each side of the Rhine. It is apparent that the Germans are not entirely satisfied with the arrangement, but the French are continuing to work for closer union. It is declared in France that no plan exists for a world sales syndicate, but it is known that this is the end to which the French producers are working.

The Germans are said to feel that it was a mistake to saddle themselves with a foreign loan when conditions soon after it was negotiated improved in Germany to such an extent that it would not have been necessary.

Immediate direction of the potash prospecting to be done by the Bureau of Mines in the Southwest has been assigned to J. H. Hedges, a mining engineer attached to the Bureau's staff. He is now engaged in familiarizing himself with the data which have been compiled since the work was authorized by Congress.

The next step that will be taken is to try to secure the agreements from property owners in the vicinity of one of the sites selected for drilling. If these are not readily obtainable a similar effort will be made at another of the points designated by the Geological Survey as a favorable place to drill. Five areas have been indicated by the Survey, among which there seems to be little choice.

Central Home Advocated for Chemical Societies in England

Proposal Originally Submitted Two-and-One-Half Years Ago Receives New Impetus—Site of Wembly Exposition Sold

From our London Correspondent

ABOUT two and one-half years ago Dr. E. F. Armstrong proposed the establishment of a house for the chemical societies of this country.

This topic was discussed at the Chemical Congress, and since it was first suggested by the late Lord Moulton that a central home for Chemical and Allied Societies would be of national importance, economic circumstances have forced the project into the background. The question has come up from time to time but progress has been slow on account of the natural reluctance of some of the Societies and Institutions to lose even part of their individuality. It is understood that more concrete proposals involving the formation of a company to purchase a site upon which the necessary building would gradually be erected is shortly to be put forward, but that in the initial stages it will not be possible to provide a library accommodation or club facilities. It is thought that the absence of the latter will cause many possible subscribers to hold back, who would have been prepared to invest funds without thought of financial return, provided that a tangible advantage, however small, would accrue from their support.

In accordance with the recommendations of the Royal Commission for the Coal Industry a standing committee has now been appointed to advise upon the National Fuel and Power resources and the members include Sir Alfred Mond, Sir John Cadman, Sir Arthur Duckham and Milne Watson, governor of the Gas Light and Coke Co. It is rumored that in connection with the development of the Bergius Process by the I. G. in Germany, there may be corresponding developments of a tentative nature by the group of powerful industrial concerns which has been sizing up the situation and has had their technical men on the spot for some time.

The British public is beginning to wonder whether, after all, the coal strike may not drag on for a sufficient length of time to cause them inconvenience when supplies of domestic fuel will again be required in full measure. So far, there has been a kind of cheery optimism, partly because many industries have succeeded in carrying on without serious inconvenience and with a very slight reduction only in their margin of profit. This, of course, does not apply to the iron and steel industry, but the chemical industry in particular, has been full of vitality and actually the export of chemical products during July was over $10,000,000 in value and exceeded the corresponding figures for July of last year. The quantity of coal imported weekly into this country is at present about 1,000,000 tons and about 250,000 tons are being produced or raised in one way and another, so that the available fuel resources are about one-quarter of the normal production and say one-third of the normal consumption. The actual loss to the country is, of course, much greater than the value of the coal and the loss of wages, but there is a growing feeling that it will be best in the long run to let the strike work itself out to its logical and truly economic conclusion, realizing that anything else might be fatal to the ordered and competitive future of British industries.

The noise made by last month's Chemical Congress is still echoing through the press and has been accentuated by the very special nature of this year's meeting of the British Association, at which the Prince of Wales presided. Although the British Associatiion meetings are sometimes regarded by the daily press with a certain amount of levity, a great deal of good has been done to chemical science, not only by recent publicity, but because the proceedings of the Chemical Section were distinctly dignified and informative. In fact, the business world is increasingly beginning to understand the value of the chemist to the community and the chemical enineer also is being increasingly recognized, largely through the Institution of Chemical Engineers, which recently held its first examination. The papers set for qualification as associate member would be found difficult by many of the older and fully experienced members of the profession, and it is gratifying to note the obvious intention of setting a high standard from the very beginning.

The site of the Wembley Exhibition has been sold to a syndicate controlled by James White and there are persistent rumors that the ultimate owners are to be the English organization of the General Motors Corporation of America. The proposal to use the exhibition for next year's British Industries Fair has been rejected, and having regard to the rapid building developments in the neighborhood, the purchase price of about 1½ million dollars seems very low.

Something of a miniature boom has been taking place in regard to the shares of the British Dyestuffs Corporation, which declared their first dividend recently, and at the present price of about 2½ dollars, the shares do not appear to be undervalued. It is rumored that there has been a good deal of buying of these shares on Continental account and, of course, the Corporations holding in Scottish Dyes, Ltd., which are making such satisfactory progress, may be a contributing factor.

Production of Peat Fuel Favored In Canada

There has recently been issued the final report of the peat committee appointed jointly by the governments of the Dominion of Canada and the province of Ontario, in the form of a comprehensive monograph: Peat, its manufacture and uses, under the authorship of B. F. Haanel, honorary secretary and member of the committee.

The report sets forth the findings of the joint peat committee resulting from the investigation which they conducted from 1918 to 1922. The subject of peat is discussed in respect to its origin, its chemical properties, the attempts which have been made in Europe and other countries to manufacture peat on a commercial basis, and its application as a fuel for production of power, gas, fertilizers, etc.

The peat committee draws the conclusions that the commercial production of peat fuel on a large scale can be conducted on many of the bogs which have been examined in detail, and which are favorably situated with regard to communities and transportation facilities. The report also states that "many of the methods which have been proposed and tried out on an experimental, and, in some instances, on a commercial scale, depend upon the elimination of the large amount of moisture contained in the raw peat by artificial drying, pressing in either hydraulic or filter presses, treatment by electric current or other artificial means. None of these have proved economically successful." The air-dried machine peat process was found to be the only one in successful commercial operation, or even giving the slightest promise of success. The committee, therefore, eliminated all methods of process which depend on artificial means for the separation of moisture, and concentrated their efforts on the devising of ways and means for carrying out in the most economical manner possible the various stages of the air-dried machine peat process.

Tank Car Specification Discussed at Conference

A conference on tank car specifications was held before the Interstate Commerce Commission on September 10. The conference was to have been held August 15, but was cancelled due to the inability of the Bureau of Explosives to be represented at that time. Sharp differences exist between the Interstate Commerce Commission and the Bureau of Explosives as to the scope of the proposed regulations. The Bureau contends that the statute does not contemplate more than general regulation. The Interstate Commerce Commission feels that in taking over the specifications of the American Railway Association they should have the force of law.

Mineral Resources of the U. S. in 1925

The Bureau of Mines has just issued its eighth annual preliminary summary of the mineral production of this country. The summary appears in booklet form under the title "Mineral Resources of The United States in 1925." Statistics given include those for production, shipments from mines, and importations of mineral products including quantities and values for receipts from foreign countries.

High Prices for Chemicals Affect Trading in French Markets

Prohibitive Costs Also Cause Sustitution of Materials in Manufacture of Apparatus—German Control of French Dye Companies Prevented

From Our Paris Correspondent

OWING to the unsteadiness of exchange prices many chemical products in French markets have been rising to very high levels. For instance pure glycerine has reached a price of 26 francs per kilo as compared with 2 francs per kilo in 1914. Formaldehyde has sold at 10 francs per kilo, bromine at 34 francs, and other products at proportionately high levels.

Metals which have wide application in the chemical industries also have seen their prices rise to unheard of proportions. Thus, lead, which is utilized on a very large scale, costs 7 francs per kilo or twelve times its price prior to 1914. One can figure what, under such circumstances, is the cost of apparatus for which lead is absolutely necessary. Many plants are using linings made of silicate bricks which are bound by cement or even by fused sulphur. This silicate material is especially recommended in lined tanks where no agitators are required which would cause the brick lining to be damaged. Such bricks have been successfully used in France for the lining of tanks and apparatus used in the manufacture of synthetic nitric acid by the oxidation of ammonia.

The prices for all precious metals and particularly for platinum (one kilo costs 160,000 francs) are excluding their current use in the chemical industries. The latter metal has to be given up also as a catalizing agent. For the concentration of sulphuric acid particularly, we are using Volvic lava as far as concentrated acid is absolutely required. This applies only to acid having to be carried a great distance from its place of production.

The sulphuric acid industry is active and prices for this product are rising every day. Actually sulphuric acid is much dearer than muriatic acid, prices for which were recently so much higher than that of sulphuric acid that certain consumers, especially pickling plants, had practically given up its use. Before the war the manufacture of sulphuric acid was almost entirely in the hands of the Saint-Bobain combine. But since the war the latter has met an important rival in the Kuhlmann concern. Both groups together are now in control of the French sulphuric acid market.

The Kuhlmann concern has taken the necessary steps to have its capital increased from 180 to 190 million by the creation of 10 million privileged shares with obligatory registration. The new stock is not transferable without the consent of the board of administration. The privilege bestowed on it consists in special rights which enable stockholders to keep the majority at the shareholders meetings. Owing to the devaluation of French currency, the Germans have bought a large block of Kuhlmann stocks, which was made clear by the steady rising of the stock in the past two months, from 400 to 1,000 francs. These secret buying manouvres by which the German dye industry is obtaining the control of the largest dye company in France has caused a big stir in industrial and financial circles of France.

It is interesting at this time to recall how our greatest dye concern came into existence. In 1916, during the war, when the Compagnie Nationale des Matières Colorantes was formed, all shares were registered and could be purchased only by Frenchmen. The State had an effective control over the company. But in 1919 the directors decided to free the company from the State's guardianship and since then sales of stock have been unrestricted. The Compagnie des Matières Colorantes then agreed to receive patents and formulas from the German dye industry in exchange for a proration of trade in determined countries. When the Compagnie des Matières Colorantes merged with Kuhlmann, the latter announced that the accord was no longer in operation. Since then the Germans have sought revenge. Through cleverly concealed stock exchange operations they succeeded in obtaining control of the majority of stock of the Kuhlmann combine as they had formerly operated with the Durand & Huguenin concern whose dye works are situated at Basilea, Switzerland. It is remarkable that during the war the Compagnie des Matières Colorantes had in hand the whole stock of this combine. In order to take advantage of the currency of the Swiss franc, the Compagnie des Matières Colorantes sold this stock of Durand & Huguenin to the Farbenfabrik Bayer & Co., which concern is a member of the well known I. G.

It is noted that the company of Alais, Froges, Camargue, another powerful concern of our chemical industry, is going to do like Kuhlmann in order to prevent German intermeddling in the management of the company. A meeting of the stockholders is to be held in September.

Franco-German Agreement

On August 5, France and Germany concluded a new temporary agreement of six months' duration. Our chemical industries are rather parsimoniously represented in this accord if we consider that of the 700 products enumerated in the French custom tariff only 33 chemicals are mentioned. Among the products of which Germany is authorized to import in Franch in limited quantities, are included:

	Tons
Potassium and sodium bichromate	600
Carbon tetrachloride	120
Caustic potash	500
Lithopone	500

For sodium and potassium bichromate we have already made known the French position in our March correspondence. For caustic potash one does not see why this import has been favored. French production af caustic potash and soda is not only sufficient but we are even an exporter. The principal producers are the powerful Solvay concern and Marchéville-Daguin & Co. Kuhlmann planned to turn out these products, especially sodium carbonate, at its work at Dieuze, Lorraine, but had to give up the idea, competition with the above named combines being impossible by the fact of a quasi monopoly.

Caustic potash is however produced at Thann by the Fabrique des Produits Chimiques de Thann & de Mulhouse. This product is obtained by electrolysis starting with potassium chloride which comes from the neighboring potash mines and in particular from the "Amélie" shaft. The process used by Thann & Mulhouse is that employing a quicksilver cathode. The price reached by mercury, 85 francs per kilo, tells sufficiently how much the installation of this process will cost and what care must be taken to regenerate the metal utilized for the reaction. This process gives immediately and directly a caustic potash solution which is brought on the market without any other operation. By evaporating in iron boilers an anhydrous product may be prepared.

The Fabrique des Produits Chimiques de Thann & de Mulhouse also turns out titanic white starting from ilmenite which must be imported. This pigment is also prepared by the Société Industrielle du Titane. This product is enjoying increasing uses in numerous industries.

Among the other German chemical products authorized to enter in France at the minimum tariff is magnesium chloride, the French production of which is insufficient both in quantity and in quality.

Large Production of Fish Oil in British Columbia

Assistant trade commissioner J. B Richards at Ottawa reports that the pilchard, a small fish which abounds apparently in limited quantities off the coast of British Columbia during summer and fall months, has been found to be of commercial value and is being exploited on a commercial scale. It has been considered too oily to be of value for human consumption but the oil may be used in the manufacture of paints, varnishes, soaps, margarine, and medicines. About $2,000,000 has been invested this summer in equipment, and plants at present in operation are capable of handling 200 tons of pilchards per hour. Since they produce nearly 60 gal. of oil per ton, worth from 35 to 40c. a gal. and since many of the plants are prepared to operate day and night during the peak of the pilchard run, the extent of the industry may be appreciated. The fish are caught in special seines and fed into a machine which macerates, cooks and manipulates them under tremendous pressure, the oil being released into tanks and the residue, in the form of dry meal, into sacks.

Larger Methanol Output Planned for Germany

Improved Process Reduces Manufacturing Costs—Sale of Bergius Process Under Negotiation

Berlin Correspondence

Not only in Germany but also in England the new Bergius process for the production of synthetic mineral oil from coal has been tried out on a large scale. The English company has set aside £25,000 for the equipment of new laboratories. According to estimates of the German company it will cost about 8 million marks for the erection of a factory capable of supplying 50,000 tons of oil annually. The price per ton of the final product is calculated at 92 marks which may be reduced to 78 marks if the factory is provided with its own supply of electric energy. Taking into consideration present prices for oli it is possible to count upon a market value of 140 to 190 marks per ton, the difference being dependent on the production of lubrication oil. It is therefore safe to assume that the production of synthetic oil from coal by the Bergius process would be profitable as it leaves a margin over the world market prices for oil by about 40 per cent to 60 per cent.

Regarding the negotiations between the I. G. Farbenindustrie and Standard Oil as well as Royal Dutch Shell it may be mentioned that the same are not so much concerning the Bergius process as other patents which the I. G. Farbenindustrie has in its possession. Among the latter mention is made of methanol, the process for which has been improved considerably so that any quantities may be produced profitably. The methanol patents have not been sold yet. A general use of methanol for motors was far out of the question on account of its high price but a solution seems to have been found in the ability to manufacture it at a much lower cost. A large factory will be built at Bitterfeld with a capacity of 1,000 tons daily, and it seems that the I. G. Farbenindustrie also intends to enlarge its production of methanol. The connection which the I. G. Farbenindustrie has established with Standard Oil and Royal Dutch Shell is said to be only indirectly responsible for the production of synthetic oil and petrol and that the formation of the German Gasoline Co. was for the sole purpose of obtaining oil and petrol from abroad.

According to the latest reports current the I. G. Farbenindustrie is trying to sell its new patents for the production of synthetic oil and petrol to either of the two groups controlling the world market, Standard Oil or Royal Dutch Shell, but it seems that the negotiations are delayed owing to the desire of the I. G. Farbenindustrie to come to an agreement with both parties at the same time.

At a recent meeting of the shareholders of the I. G. Farbenindustrie it was proposed to increase the capital by 554 million marks to a total of 1,100 million marks, thus bringing this concern again to the front of all German industrial enterprises in the matter of capital. The new funds will be used in the main for the extension of the nitrogen plants which have been found necessary on account of an increased demand from abroad, and part of it is planned for the erection of factory buildings to utilize the Bergius process for the manufacture of synthetic oil.

Canada Increased Imports of Chemicals Last Year

Canada's imports of chemical products during the twelve months ended June, amounted in value to $29,341,193, an increase of $3,764,469 compared with the previous twelve months. The principal increases were in imports of drugs and medicines, fertilizers, and paints and varnish. Imports of drugs and medicines totalled $3,022,032, an increased of $290,685. Imports of paints and varnish amounted to $4,095,770, an increase of $653,305. In the imports of the latter commodity from the United States there was an increase of $559,107, while there was a gain of $147,805 in the imports from the United Kingdom. Total imports of fertilizers were $3,595,517, a betterment of $952,348. Purchases in the United States amounted to $2,229,143, a gain of $483,087. The imports of dying and tanning materials amounted to $3,197,270, a decrease of $429,637. Imports from the United States were $2,124,203, a falling off of $354,353. There was also a slight decrease in the imports from the United Kingdom. Total imports of sodium compounds were $2,848,543, a gain of $311,743. The United States supplied the bulk of these purchases. In imports of potassium compounds and soap there were slight increases.

The imports of clay products totalled $7,812,000, being an increase of nearly $800,000. The gain in purchases from the United States was $241,000, while the increase in imports of these products from the United Kingdom was $119,000.

News in Brief

Process for Oil Extraction From Tar Sand.—A syndicate has been formed to test out a process of extracting oil from the vast areas of tar sands in the northern portion of the province of Alberta, Canada. J. O. Absher, an experienced oil man and refinery operator who has been working in the interests of the syndicate, claims to have invented a process which will prove successful.

Fusion of Mineral Color Companies in Germany—Trade Commissioner W. T. Daugherty in a report from Berlin states that two of Germany's oldest and most prominent manufacturers of mineral colors have just combined into a complete fusion. They are Gebrueder Heyl & Co., Berlin-Charlottenburg, and A. Behringer G. m. b. H. The former separate companies will be commonly operated by a new concern just formed —Heyl-Behringer Farbenfabriken Aktien Gesellschaft—with a capital foundation of one million marks. Production costs will be lowered, it is said, by introduction of new processes, and by economies possible through the fusion. The combination purposes to make special efforts to develop business with outside countries.

Great Britain Decreases Output of Sulphuric Acid—At the recent chemical congress in London, it was stated that before the World War, Great Britain produced 1,083,000 long tons of sulphuric acid, whereas in 1925 the figure had fallen to 848,000 tons. The prewar capacity in chamber acid was 1,040,000 tons, and in oleum, 22,000 tons, while the post-war capacity was 1,265,000 tons of chamber acid and 450,000 tons of oleum. It was further asserted that the use of sulphuric acid for fertilizers in the form of superphosphates was declining. Before the War, 88½ per cent of the sulphuric acid produced in Great Britain was made from pyrites, while last year the percentage dropped to 46. The use of brimstone accounted for 24 per cent, spent oxide 24 per cent, and zinc and copper fumes, 5½ per cent.

New Paint Company Operating in Canada—The Furolin Paint Manufacturing Co. of Canada, Limited, has been organized at Sault Ste. Marie, Ontario, with a capital of $150,000 and will undertake the manufacture of fireproof paints and liquids. Manufacturing was scheduled to begin early in September and the first year's output will be about 300,000 gal.

Rosin Shipments in Barrels Held Reasonable—After public hearings and an extended inxestigation, Martin J. Walsh, an examiner of the Interstate Commerce Commission, recommends that the Commission find that there is nothing unreasonable or otherwise unlawful in the requirement that carload shipments of rosin be in barrels. The complainant in this case was the Vera Chemical Co., of Canada. The examiner, however, supports the chemical company's claim that certain rates on rosin from Gulf ports to Burlington, Ontario, are unreasonable.

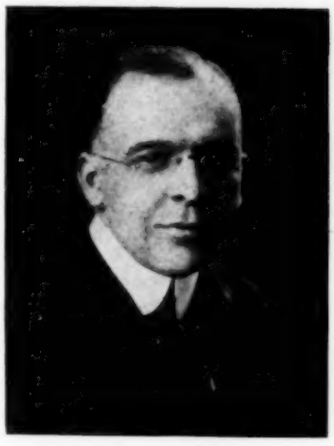
Sales of Domestic Kaolin Increased Last Year.—The Bureau of Mines reports sales of domestic Kaolin, or China clay, in 1925 as amounting to 367,319 tons valued at $3,220,719. These figures represent an increase of 12 per cent in quantity and 10 per cent in value as compared with the totals reported for 1924.

Potash Price Increase Proposed in Germany.—At a meeting on Aug. 11, the Federal Potash Council of Germany, approved a proposed increase in the inland prices of potash by 12 per cent, to be effective Sept. 1. Thirteen members of the Council voted for and nine against the increase, while four members did not vote. Opposition to the increase was voiced by agriculture and labor representatives while the Syndicate and commercial delegates favored it.

Manufacturing Chemists Will Discuss Container Specifications.—Further amendments to shipping container specifications will be considered by the executive committee of the Manufacturing Chemists' Association when it meets at India House, New York, Sept. 15 for its fall meeting. The other matters on the program for consideration are of a routine character.

Men You Should Know About

Dr. GEORGE DENTON BEAL has been appointed to an assistant directorship of the Mellon Institute of Industrial Research, University of Pittsburgh. Dr. Beal has had a distinguished career in chemistry and is an authority on quantitative organic analysis and on chemical properties of pharmaceutical products. He was born in Scio, Ohio, on August 12, 1887. He was educated at Scio College, and later pursued advanced study at Columbia University. He was an assistant in chemistry at Scio College during the period 1906-1908, and since 1911 has been a member of the faculty of the Department



Dr. George Denton Beal

of Chemistry, University of Illinois, where since 1920 he has been associate professor. As a member of the Executive Staff of Mellon Institute, Dr. Beal will be in supervisory charge of industrial fellowships that are conducting researches in the field of pharmaceutical chemistry. He assumed this new post on September 1.

W. M. WEIGEL, for five and one-half years associated with the Bureau of Mines in its studies of the production and utilization of non-metallic minerals, is now mineral technologist for the Missouri Pacific Railroad. His headquarters are in the Railway Exchange Building in St. Louis. Mr. Weigel is making a survey of the mineral resources in the Missouri Pacific territory with the object of assisting the producer and consumers of these commodities.

F. P. HALL of New York, formerly research chemist for the Standard Oil Co., is now connected with the United States Bureau of Standards at Columbus, Ohio, as associate research chemist.

HARVEY S. FIRESTONE, JR., director and official of the Firestone Tire & Rubber Co., Akron, Ohio, has sailed for Liberia, Africa, where he will remain for several months making a survey of rubber plantations of the Firestone Plantation Co., a subsidiary organization, and arranging for development work in connection with additional acreage.

SAMUEL J. HUNT has resigned as director of lubrication engineering for the National Petroleum Marketers' Association and the Independent Oil Men of America, effective Sept. 15, to assume the directorship of the lubrication division of the Armould Oil Co., Quincy, Ill.

W. S. LANDIS, vice-president in charge of technical development for the American Cyanamid Co., has left for a business trip to Sweden, and will be absent for a number of weeks.

H. B. DUBOIS has become ceramic engineer for the Pennsylvania Pulverizing Co., Lewiston, Pa. He was formerly connected with the Standard Tile Co., Zanesville, O.

JOHN W. MAPEL has been elected president of the Goodyear Tire and Rubber Co. of California, Inc., Los Angles, to succeed E. G. Wilmer, resigned.

JOSEPH H. EHLERS has been appointed engineering trade commissioner for the U. S. Department of Commerce at Tokyo, Japan. He was born at Hartford, Conn., and was educated at Trinity College.

W. A. RAINE, heretofore chief chemist for the Union Oil Co. of California, Los Angeles, has been appointed manager of research and development for the company, with headquarters at Wilmington, Los Angeles Harbor. D. R. Merrill has been appointed assistant to Mr. Raine, with title of assistant manager of research and development. T. F. Ott has been appointed lubricating technologist for the company.

GEORGE D. DUNHAM, assistant superintendent of the White Eagle Oil & Refining Company's plant at Augusta, Kansas, has been appointed superintendent of the company's Fort Worth, Texas, refinery, to take the place of Henry G. Nevitt, resigned. Before going to the Augusta plant Mr. Dunham helped build the White Eagle's refinery at Casper, Wyo., and also worked at Parco, with the Producers & Refiners Corp. He is a graduate of Cornell University.

HENRY G. NEVITT, formerly with the Fort Worth plant of the White Eagle Oil & Refining Company is now at the Augusta, Kansas, plant.

HAROLD M. GRAHAM has joined the Ross Heater and Manufacturing Co., Inc., Buffalo, N. Y., as chief engineer.

G. ST. J. PERROTT, an explosives chemist on the staff of the Bureau of Mines, is to visit the United Kingdom, France, Belgium and Germany to inquire into the methods used in those countries in the handling and testing of explosives.

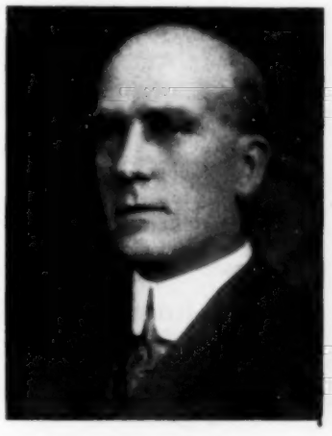
REINHARDT THIESSEN, who has spent more than a year in England working with the British on studies of the microstructure of coke, has completed his assignment and will return to this country to resume his place on the staff of the Bureau of Mines.

WALTER C. SMITH has resigned as metallurgist with the Baltimore Copper Smelting & Rolling Co., Baltimore, Md., to accept a position as metallurgist with the Primos Company, Philadelphia, Pa.

FREDERICK S. BACON, formerly president of the Puritan Dye and Chemical Company, has joined the organization of Arthur D. Little, Inc., of Cambridge, Mass.

GEORGE NORMAN, technical director of the Hercules Powder Co. and H. E. Kaiser, director of the research station, have returned from a two-months' visit to England and Europe.

Dr. RICHARD B. MOORE has resigned as general manager of the Dorr Co. to become Dean of the School of Science of Purdue University and head of the chemistry department. He will have charge of the development of important work, including the building of a new laboratory and research organization,



Dr. Richard B. Moore

and will also carry on consulting work. Dr. Moore has been with the Dorr Company since May, 1924, previous to which he was chief chemist of the U. S. Bureau of Mines.

JOHN MCGEORGE, at one time chief engineer for the Wellman-Seaver-Morgan Co., and recently plant engineer for General Motors, Oakland-Pontiac plant, is now in charge of the oven and conveyor engineering department of McCann-Harrison Corp., Cleveland, Ohio.

B. R. BATES has left the Dorr Co. to become associated with the Permutit Company.

EDWARD P. MATHEWSON, metallurgist, announces the removal of his offices from 42 Broadway, New York City, to University Station, Tucson, Arizona.

J. V. N. DORR, president of The Dorr Company, returned from a short trip to Europe on September 1.

S. C. LIND has accepted the directorship of the School of Chemistry at the University of Minnesota, taking up his duties at the beginning of the academic year the latter part of September. At Minnesota, besides acting as director of the School of Chemistry he expects to inaugurate a new division to be called "photo- and radio-chemistry." The work of the division will be concerned with the chemical effects of light and of other types of radiation also with the chemistry of the radio-elements and the chemical phases of

radioactivity in general. He personally will give the courses and conduct research in those subjects.

LESTER O. WARNER, who has been in charge of research for the Signal Hill Gasoline Company of Long Beach, Calif., a subsidiary of the United Oil Company, has resigned to become a member of Barton, Manning & Warner, consulting engineers. Mr. Warner is a graduate of California Institute of Technology and his work with the United Oil Company dates over a period of three years including experience in operation, design and construction before he was given charge of research. His address is 701 South Palm Ave., Alhambra, Calif.

NORMAN W. KRASE, formerly instructor in chemical engineering at Yale, is now assistant professor in the chemical engineering division of the department of chemistry, University of Illinois.

M. G. CORSON (M. G. Korsunsky) for four years non-ferrous research metallurgist with the Union Carbide and Carbon Research Laboratories recently resigned his position to engage in consulting work in non-ferrous metallurgy and industrial chemistry.

Obituary

ALBRECHT PAGENSTECHER of Newburgh, N. Y., a pioneer in the wood pulp and paper industry, died at his local residence, Aug. 6, aged 88 years. Mr. Pagenstecher is credited with having introduced the making of pulp from wood for newsprint papers in the United States. The first such pulp mill was located at Curtisville, Mass., now known as Interlaken; the process substituted the use of ground wood for straw. He organized and headed at different times a number of paper companies. He was a director of the International Paper Co. for many years.

CLAUDE F. CHARD, for several years Cleveland District Sales Manager of The Austin Company, Cleveland, was killed in an automobile accident on Friday, Aug. 13. He is survived by his widow and daughter.

THEODORE A. RANDALL, secretary of the National Brick Manufacturers' Association and editor-in-chief, business manager and principal owner of the *Clay Worker*, died July 23, following a major operation.

J. M. SOUTHGATE of Hammond, Ind., chief engineer for the Roxana Petroleum Co. in the construction of its new Hammond-East Chicago refinery, died Aug. 25, following an operation for appendicitis, aged 45 years.

E. G. RIPPEL, president of the Chemical & Vacuum Machinery Co., Inc., Buffalo, N. Y., died suddenly in Cleveland, Ohio, Aug. 9, 1926. Mr. Rippel was one of the progressive figures among manufacturers of chemical engineering equipment. He was first identified with the Ball Engine Co. of Erie, Pa., but he attained his greatest recognition in his management of the Buffalo Foundry and Machine Co., which he organized in 1901 and from which he retired in 1922. During this

E. G. Rippel

period of 21 years he achieved for his company an excellent reputation and widespread publicity. He was an exponent of industrial research and developed a research laboratory as an important adjunct to the company's operations. His advertising and publicity work were conceived on a large scale, as a result of which he brought his company prominently to the attention of the chemical engineering industries. He was one of the strong backers of the Chemical Exposition in its early years and his exhibits were one of the outstanding features of the annual show. After his retirement from the Buffalo Foundry and Machine Co. he spent a year or two in travel and recreation, after which he organized the Chemical and Vacuum Machinery Co., of which he was president at the time of his death. Mr. Rippel was born in Dover, Ohio, in 1869. He is survived by his wife and daughter.

Calendar

AMERICAN CHEMICAL SOCIETY, Richmond, Va., April 12-16, 1927.

AMERICAN ELECTROCHEMICAL SOCIETY, Washington, D. C., Oct. 7, 8 and 9.

AMERICAN GAS ASSN., 8th annual convention and exhibition, Atlantic City, N. J., Oct. 11-15, 1926.

AMERICAN INSTITUTE OF CHEMICAL ENGRS., Atlanta, Ga., and Birmingham, Ala., Dec. 6 to 10.

AMERICAN WELDING SOCIETY, Fall meeting, Buffalo, Nov. 17, 18 and 19.

ASPHALT ASSN., The Assn. of Asphalt Technologists and the American Society for Municipal Improvements, will jointly and separately hold meetings, Mayflower Hotel, Washington, D. C., Nov. 8 to 12.

NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING (5th) Grand Central Palace, New York, Dec. 6 to 11.

SESQUI-CENTENNIAL INTERNATIONAL EXPOSITION, Independence Sq., Philadelphia, Pa., June 1 to Dec. 1.

SOUTHERN EXPOSITION (2nd Annual), Madison Sq. Garden, N. Y., Oct. 2-10.

TECHNICAL ASSN. OF THE PULP AND PAPER INDUSTRY, York, Pa., Sept. 14-16.

VEGETABLE GROWERS ASSN. OF AMERICA, INC., eighteenth annual convention, Cleveland, Ohio, jointly with the American Peat Society, Inc., Sept. 1? ?7.

Industrial Notes

THE ROSS HEATER & MANUFACTURING CO., INC., Buffalo, announces that Ross H. Rathbun has joined its organization as sales manager.

THE LUDLOW-SAYLOR WIRE CO., St. Louis, has transferred Frank B. Ungar, for many years Chicago representative of the company, to the general offices in St. Louis as assistant to the general manager of sales.

THE MERCO NORDSTROM VALVE CO., San Francisco, Calif., announces that C. L. Hudson, formerly with the Houston office, is no longer with the company.

THE BRIDGEPORT BRASS CO., Bridgeport, Conn., announces that J. N. Joyce, formerly of Johns-Manville Co., is now in the Cleveland sales office. The New York office has been moved to 475 Fifth Ave.

THE QUIGLEY FURNACE SPECIALTIES Co., New York, announces the appointment of S. F. Murphy, Jr., in its service department at San Francisco. He will cover the entire west coast, California, Colorado, Texas, Utah, Oregon, Washington, Wyoming, British Columbia and the Orient. It is also announced that the W. H. Taylor Co. of Allentown, Pa., has been appointed distributor for Quigley products in the Allentown territory. The Eagle Oil and Supply Co. of Boston has been appointed distributors for Quigley products in Eastern Massachusetts and Rhode Island.

THE CARBORUNDUM COMPANY, Niagara Falls, N. Y., announces that Farrand Hall, who for the past several years has been district sales manager of the Cleveland territory, has been transferred to the Sales Department at the main plant at Niagara Falls. The position of district sales manager in Cleveland will be filled by Harry Collinson who will be transferred from a like position at Milwaukee. To succeed Mr. Collinson at Milwaukee, the Carborundum Company announces the appointment of Carl J. Steuber who was formerly a special service representative in the Carborundum coated abrasive division.

THE BRISTOL COMPANY, Waterbury, Conn., announces the opening of a branch sales and service office in the U. S. National Bank Bldg., Denver, Colo., with H. T. Weeks, representative, in charge.

THE FOOTE BROS. GEAR AND MACHINE Co., Chicago, Ill., have appointed the Roberts Tool & Supply Co. of Syracuse, N. Y., district representatives in Syracuse and vicinity, and the Indianapolis Belting and Supply Co., 34 S. Capital St., Indianapolis, Ind., as district representatives for the city of Indianapolis, and surrounding territory for a radius of 75 miles. H. G. Davis, who was formerly associated with the Pfaudler Co., Milwaukee, has recently joined the sales organization to cover the north side of the city of Chicago, and suburbs.

Market Conditions and Price Trends

Production of Leaded Gasoline Opens Wide Field for Bromine

Sources of Supply Must Be Extended to Satisfy Consuming Needs—German Prices May Be Reduced

REPORTS of record consumption of gasoline in this country together with the knowledge that the amounts passing to consumers have greatly exceeded the amounts produced, has centered attention of the industries interested, to the necessity of conserving the national supply of gasoline. Figures recently issued and covering operations for last July state that production of gasoline in that month was 24,927,000 bbl. which is a new record for the industry. In June consumption reached a total of 24,237,000 bbl. The daily average production in July was approximately 804,000 bbl. as against 808,000 bbl. in June, the extra day in July accounting for the larger total produced in that month.

Domestic consumption of gasoline in July exceeded 1,000,000,000 gal. for the first time in the history of the trade, this total including both home consumption and export shipments. The run of crude oil to stills in July is placed at 67,442,000 bbl. as compared with a domestic production of 64,972,000 bbl. The result was noted in a marked decline in stocks of crude oil and of gasoline at the end of July and if that rate of consumption for any length of time it would deplete the surplus stocks now on hand.

In view of this condition more than ordinary significance attaches to the statement made in Philadelphia last week to the effect that the discovery of tetraethyl lead, a so-called anti-knock compound for gasoline use in internal combustion engines, if universally used would be the means of cutting down the consumption of gasoline by one-third. The statement was based on the assumption that the mileage of automobiles per gal. of gas can be increased 50 per cent by the use of tetraethyl lead and if the latter had been universally used in 1925, it would have resulted in the saving of more than 3,000,000,000 gal. of gasoline.

Bromine As a Raw Material

Since bromine is used in the manufacture of tetraethyl lead, the market for this chemical is expected to be broadened in extent far beyond the ordinary standards of consumption. In 1924 and 1925 when production of tetraethyl lead began to assume importance, one of the chief concerns of producers was to find ample supplies of bromine. Domestic producers were stimulated to extend their productive operations and contracts for large amounts were placed with producers in Germany. The voluntary withdrawal of tetraethyl lead from the market, on the part of producers, pending investigations into the poisonous nature of gasoline treated with this compound, necessarily interfered with the development of this industry. The findings of the investigators, as announced early in the year, were favorable for the continuance of the production and sale of gasoline treated with tetraethyl lead. The question of an adequate supply of bromine, consequently, again came to the front and still offers a problem which must be solved.

Sources of Bromine Supply

In connection with possible sources of supply for bromine, interesting information has been gathered by C. R. DeLong, chief of the Chemical Division of the Tariff Commissoin. He has estimated that if the 11,200,000,000 gal. of gasoline consumed in this country last year, had been treated with ethylene bromide and tetraethyl lead, 90,000,000 lb. of bromine would have been required. This of course is an untenable supposition but if 10 per cent of the gasoline should be converted into leaded gasoline, the bromine requirements would reach a total of about 9,000,000 lb.

Discussing the potential bromine resources of the United States, Mr. DeLong says that the recovery of bromine from sea water would seem to offer the greatest immediate possibility of large increased domestic supplies of bromine.

Aside from this method, the potential domestic resources which offer most promise of increased supplies of bromine at the lowest cost are the brines of the Saginaw Valley, Michigan. Little attention has been paid to the bromine content of the saline waters of the United States. A thorough survey may reveal large resources of this important chemical.

Mr. DeLong does not foresee a renewal of the commercial warfare for the world's bromine market between the United States and Germany such as was carried on between 1904 and 1908. In Germany bromine is recovered from the waste liquors of potash works. Last year Germany produced about 3,000,000 pounds of bromine. This, it is thought, can be increased tenfold should market conditions warrant.

There is no occasion to fear that prices for bromine in the near future will reach the high level that existed during the World War. So far as can be seen now, any scarcity for bromine that may arise will result from unexpected demands for leaded gasoline. The bromine ship "Ethyl" should prove to be a factor of great importance and should exert a stabilizing influence on the domestic bromine market.

The extent of the domestic trade in bromine in recent years may be inferred by reference to the accompanying table which sets forth the amounts sold by domestic producers and the values as reported by producers. The figures cover from 1916 to 1925 inclusive.

Bromine Sold By U. S. Producers

	Lb.	Value	Average Value per Lb.
1916	728,520	$951,932	$1.305
1917	895,499	492,703	.550
1918	1,727,156	970,099	.561
1919	1,854,971	1,234,969	.665
1920	1,160,584	745,381	.642
1921	711,953	172,759	.242
1922	1,005,174	150,668	.149
1923	842,352	146,176	.176
1924	2,033,804	594,685	.292
1925	1,566,130	488,406	.313

Import trade in bromine also is in the following table which gives amounts and invoice values for importations for the last five years:

Bromine Imported Into United States

	Lb.	Value	Invoice Value per Lb.
1921	300	$84	$2.80
1922	1,094	339	.309
1923	782	1,171	1.497
1924	37,318	8,958	.240
1925	8,009	2,110	.263

As Germany is the principal foreign producer of bromine the domestic industry will be interested in a report from abroad which states that the Wintershall concern seems determined to give notice September 30 of its intention to withdraw from the German Bromine Syndicate. The Wintershall company is not pleased with its magnesium-chloride production quota. The rules of the syndicate provide that a member may give notice of withdrawal three months before the expiration of the calendar year. If the deadlock continues and the Wintershall interests withdraw a drop in bromine prices is expected. The German price which has been varying from two and one-half to three marks per kilogram is regarded as excessive when production costs are considered.

It is said that the Wintershall costs are around fifty pfennig per kilo. When the bromine convention was ineffective early in 1925, the price of bromine dropped to 1.20 marks in consequence. The Wintershall policy in bromine, as well as other production, is to reduce prices as it is possible, with the idea of increasing its use. That concern is particularly optimistic concerning the future of ethylene dibromide. If the Wintershall concern withdraws from the syndicate it is expected that bromine production will be begun at the new Kaiseroda works.

Market Conditions and Price Trends

Chemical Output Continues on Larger Scale Than a Year Ago

Index of Employment Indicates Gain of 2.88 Per Cent in Production Over Corresponding Period of 1925

DOMESTIC production of chemicals throughout July continued to hold the gains over 1925 as previously reported for the first half of the year. This statement is based on the figures of production gathered by the Department of Commerce and on employment figures collected by the Bureau of Labor.

Production in manufacturing industries in July declined from June according to the weighted index number of the Department of Commerce, and was also less than in July, 1925. Increases over June production were made by the chemical, clay-products and tobacco groups, while, compared with a year ago, increases in the iron-and-steel, paper, foodstuffs, clay-products, tobacco and chemical groups contrasted with declines in the leather, non-ferrous metals, miscellaneous, lumber and textile groups. The index of raw-material output and marketings was 17 per cent higher than a year ago, owing to the large increase in grain receipts among the crop marketings.

Commodity stocks on July 31 were slightly higher than in June, when allowance is made for seasonal conditions, although raw materials other than foodstuffs declined. Compared with a year ago, stocks were considerably higher, owing to the large increase in raw materials, especially foodstuffs, as manufactured commodities other than foodstuffs declined.

Unfilled orders for basic materials, chiefly iron, steel and building materials, remained unchanged from June but were less than a year ago. Iron-and-steel unfilled orders increased slightly over both previous periods while building-material orders declined, especially from a year ago.

The weighted index of employment which is compiled from reports received by the Bureau of Labor not only points to a larger production of chemicals as compared with July 1925 but also makes it apparent that consumption of chemicals in the respective periods was in favor of the current year, exceptions being found only in the textile and automobile tire industries. Statistics for the soap trade are not included in the Bureau of Labor compilation and private reports say that the sale of certain chemicals to that trade for the seven-month period are about 10 per cent larger than for the corresponding period of last year.

WEIGHTED INDEX OF EMPLOYMENT

	July 1926	June 1926	July 1925
Dyeing and finishing textiles	91.8	95.9	96.0
Leather	88.3	86.7	86.5
Paper and pulp	94.9	95.9	94.2
Chemicals	93.0	94.6	90.4
Fertilizers	74.3	74.8	67.6
Glass	94.6	100.8	91.1
Automobile tires	108.6	106.8	119.0
Petroleum refining	101.8	100.9	96.3

Absence of Price Trends

With the most important chemical products finding a steady consuming outlet and with no drastic changes in production costs, it is difficult to perceive any real trend to market values. Miscellaneous price changes are frequent enough to cause a shifting in the average of values but these fluctuations generally are due to the existence of particular conditions surrounding the commodity affected.

The weighted index number for chemicals now stands at 113.59 which compares with 113.33 a month ago, 112.84 in September, 1925, and 110.94 in September, 1924. Values, therefore, are holding above the levels in effect at the corresponding periods for the last two years and undoubtedly the upward revision in the index number has followed as a result of more active and more sustained buying.

Since production of vegetable oils and fats is dependent on raw materials of natural growth, changing prices for the former generally can be traced to influences arising from the position of raw materials. A large yield of cottonseed is in sight for the coming year and this has checked advances in the cottonseed oil market. Linseed oil has eased off during the month although the domestic seed supply is not of a character to arouse belief in a lower priced market for oil.

The weighted index number for oils and fats registers at 154.26. This represents a decline of 2.24 points as compared with the number a month ago. In September, 1925, the weighted number was 156.04 and in September, 1924, it was 142.68.

Gain in Export Trade

Analysis of foreign trade in chemicals and allied products as reported by the Bureau of Foreign and Domestic Commerce, shows that in July, outward shipments of these products were valued at 9 per cent above the total reported for July, 1925, the figures being $16,426,000 and $15,087,000 respectively.

Conditions in manufacturing industries in August also are reported to have been favorable with curtailment influenced by seasonal developments rather than by any drastic change in industrial conditions. In some cases, production in August was on an enlarged scale. The output of steel ingots in that month, for instance, was reported at the highest level since last April and approximated 4,000,000 gross tons.

The outlook for consumption of chemicals in the fall months is regarded as encouraging. Reports from glass-making centers announce the reopening of plants. Textile mills in New England generally have started up after the summer vacation period and some of them are now running at capacity. Petroleum has been going along uninterruptedly and advices from Texas state that three of the large companies operating in that state are planning to enlarge their refineries in order to facilitate handling of the larger output of crude oil. Shipments of sulphur which up to July had been unusually heavy, offered a notable exception to the general rule and amounted to only 20,000 tons with a valuation of $367,000.

Due to the continued high price of rosin and turpentine the naval stores group exports were 38 per cent over those of July, 1925, and attained an aggregate value of $4,631,000. Outgoing shipments of rosin amounted to $3,044,000, 134,000 bbl., and of turpentine to $1,430,500, 1,568,000 gal. Wood turpentine sales were also rather high and equalled $61,000, 76,000 gal.

Import Trade Declines

The declared value of chemical imports into this country in July was $14,072,000. This is a decline of 6 per cent in comparison with imports in July, 1925. Among the imports, coal-tar products made a good showing but fertilizer materials lost heavily in volume.

Imports of gums and resins, valued at $2,327,000, were 6 per cent less than preceding July. This falling off was largely due to the smaller receipts of natural crude camphor as well as of synthetic camphor, $39,200, 65,200 lb. of the former and $58,200, 107,400 lb. of the latter having entered the United States. Varnish gums imported were 7 per cent in value but 33 per cent in quantity over July, 1925, and equalled $1,562,000, 7,786,000 lb.

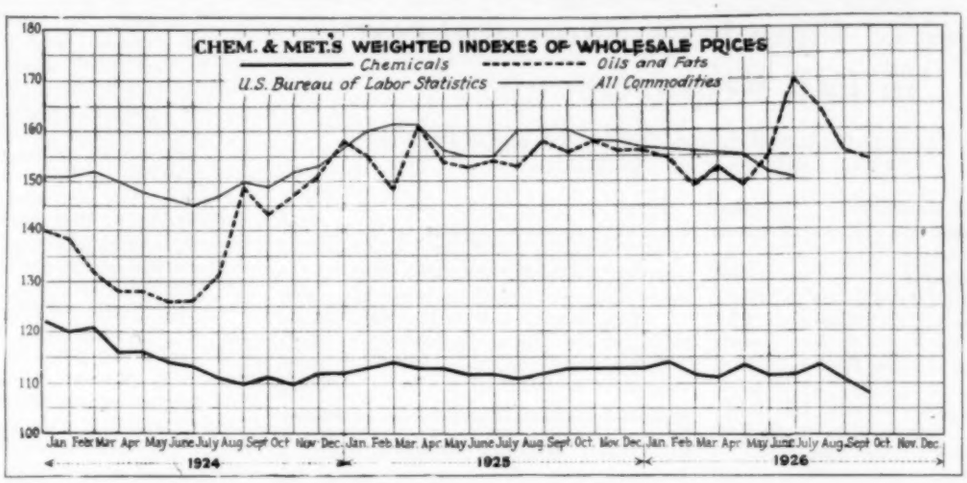
Japanese Government Will Make Ammonium Sulphate

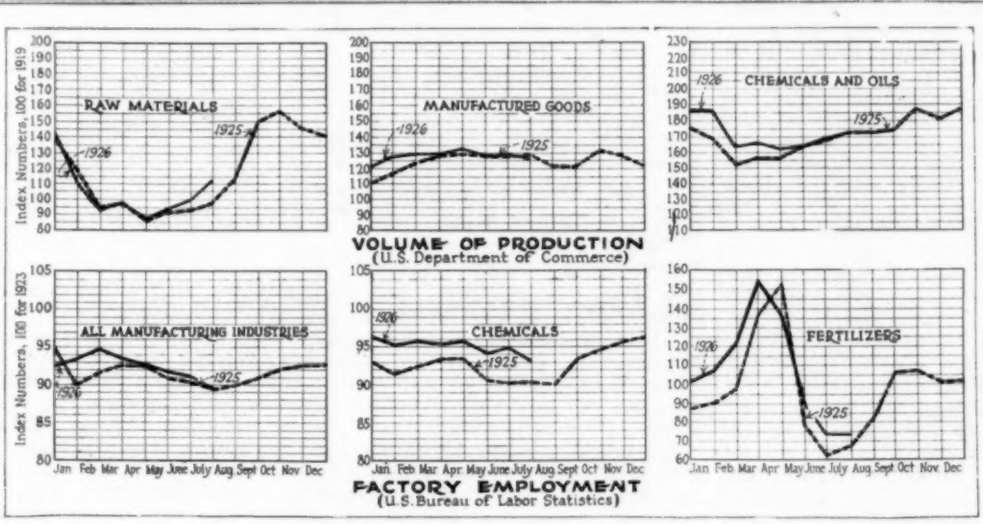
According to a report from the acting commercial attache, at Tokyo, the Japanese government, through its Department of Commerce and Industry, will undertake to manufacture ammonium sulphate by the Haber process, which was acquired from Germany as war indemnity. The government plans to erect a factory capable of producing four tons per day.

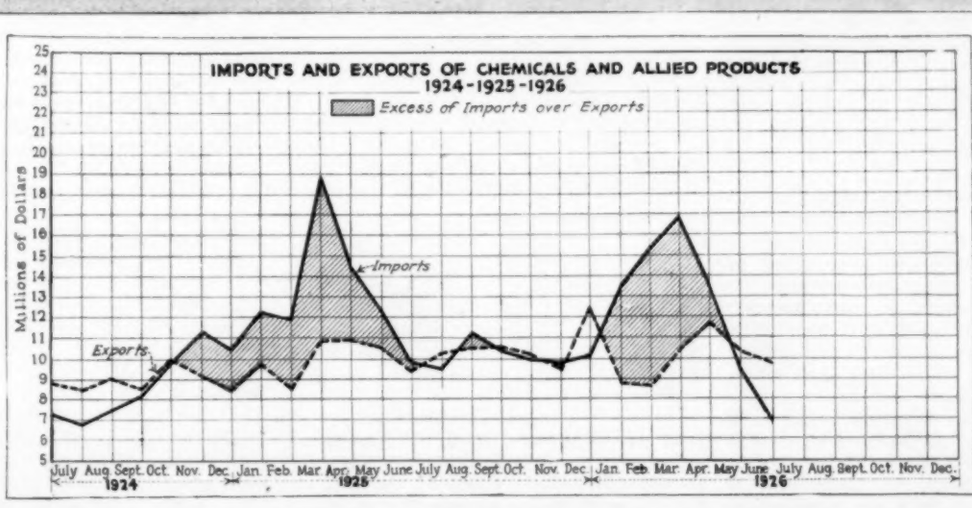
The Mitsui and Mitsubishi interests have been using the Haber process with the government's permission. Due to lack of success, these interests are reported to be willing to withdraw.

CHEM.&MET. Statistics of Business

In the Chemical Engineering Industries







Market Conditions and Price Trends

Buyers of Chemicals Show Interest in Fall Requirements

Inquiries for Prompt and Later Deliveries Have Increased Since the First of the Month

FOR THE greater part of the past month demand for chemical products was of a routine nature with seasonal dullness apparent in the trade. Contract deliveries were going forward in usual volume but new business was light. Since the first of the month there has been a change for the better and buying interest is reported to have awakened. The spot market has been more active and contract business has been placed in some selections.

A firmer price tone also has been manifest and the weighted index number for chemicals is slightly higher than it was a month ago, the numbers being 113.59 and 113.33 respectively. Alcohol is included among the materials for which advanced prices are in effect.

The market for bleaching powder has been free from selling pressure and holdings at works are reported to have been relatively light throughout the hot weather period. This was the result of restricted operations at plants and in some cases production was entirely discontinued. The situation with regard to liquid chlorine has been less favorable as production has continued along active lines and sales have not been large enough to take up stocks. It is probable that surplus stocks will force a curtailment of production.

Interest in sulphur was increased by the report of the formation of a new company which plans to operate in Texas. Export trade in sulphur has not been maintained as July shipments abroad showed a marked decline from the totals of preceding months. Competition from pyrites also is more of a factor and during the first six months of 1926 there were 203,968 long tons of pyrites entered for consumption in the United States. If the importations continue at the same rate, the receipts for the year 1926 will be considerably higher than the average annual receipts of 262,289 tons for the years 1923-1925 inclusive.

One of the important features to trading in the last month was the higher selling level for industrial alcohol. Leading producers were quick to follow the lead when an advance in price was announced in one quarter. The lack of price-cutting competition is in marked contrast to conditions which existed a short time ago when surplus stocks depressed the market. Methanol, likewise, has been firmly held and the fact that arrivals of synthetic methanol from abroad have been relatively light appears to have had a stimulating effect both on production and consumption of the domestic product.

Most of the metal salts showed a tendency toward firmer values but these chemicals generally are influenced more by the metal markets than by demand from consuming industries. The tin salts responded to a higher average price for the metal by a sharp upward revision in the schedule for September delivery. Copper sulphate has undergone a very satisfactory season as far as buying on the part of the agricultural trade is concerned. The tonnage movement was unusually large and had a steadying effect on values. With the cessation of this buying values have shown an easier tendency.

The monthly report of the Crop Reporting Bureau was issued on Sept. 10 and placed condition of the growing flax crop on Sept. 1 at 62.8 with an indicated total yield of 19,255,000 bu.

Leading Market Developments During the Month

Reports from abroad indicate that prices for bromine in Germany may be lowered through competitive selling.

Depression in nitrate of soda trade has resulted in reducing the number of plants operating in Chile.

Lessened production bleaching powder through the summer months has limited available supplies.

Calcium arsenate experieenced a revival of consuming demands and sales were made at advanced prices.

Suplus stocks of industrial alcohol appear to have been reduced and producers named higher prices for September delivery.

Nitrate of Soda Prices Will Not Be Reduced

On August 11, the directors of the Nitrate Producers Association held a meeting at Valparaiso and confirmed the schedule of prices which had been agreed upon earlier in the year. This refers to nitrate deliveries in the fiscal year which began July 1. It had been hoped by producers that the Chilean government would come to the aid of the industry to the extent of removing, or at least reducing, the export tax which now is enforced. The government, however, did not look with favor on this proposal and it has been definitely announced that the export tax will not be modified. There were some reports that the government would dissolve the Nitrate Producers Association, but it was anounced that no such action would be taken during the present year. The continuance of the association after this year, however, is rendered doubtful.

The situation in the nitrate industry failed to improve during the month and if anything the industry has worked into a less favorable position. The commercial attaché at Santiago explains the present situation by saying that according to official records, the nitrate sales for the year ending June 30, 1926, were approximately 20 per cent less by volume than the previous year. The surplus stock of nitrate and consequent curtailment in production, has brought about a serious situation in the mining districts. Where plants have been closed, employees have returned to their homes in the agricultural regions, with a natural reaction on the labor situation there, and a greater drain on the credit conditions throughout the country in general.

The reason for the decrease in demand can be found in the record of exports of nitrate during the last year. The United States has been buying and consuming approximately 45 per cent of the Chilean production, as compared with 20 per cent before the war, when Germany was the principal buyer. But Germany has recently introduced synthetic nitrate to her home markets, and built a tariff wall against the Chilean product, at the same time writing off the cost of domestic nitrate plants as a war debt and operating on a plan that takes little account of capital investment from this source.

The number of nitrate plants in operation has declined from 91 at the beginning of the year to 49 at the end of July. Exports in recent months have been at a rate considerably below production so that stocks at the shipping points have increased to unusual amounts. There, also, are large stocks held for orders at producing points and in distributing centers in Europe.

The position of the industry in Chile is made evident by the following figures of production and exports:

	Production 1925 Metric Tons	Production 1926 Metric Tons	No. of Plants in Operation at End of Month 1925	No. of Plants in Operation at End of Month 1926	Exports 1926 Metric Tons
January	215,985	235,000	92	89	248,000
February	185,439	220,000	93	83	180,000
March	205,084	228,000	88	79	240,000
April	180,609	216,362	84	75	114,176
May	191,642	196,700	86	65	41,300
June	192,924	170,000	89	60	95,000
July	215,395	159,466	92	49	133,423

Imports of nitrate of soda into the United States in July were 25,367 tons as compared with 68,791 tons in July, 1925. For the seven months ended July, imports were 659,263 tons in 1926 and 797,465 tons in 1925.

Market Conditions and Price Trends

Chem. & Met. Weighted Index of Chemical Prices

Base = 100 for 1913-14

This month	**113.59**
Last month	113.33
September, 1925	112.84
September, 1924	110.94

Firmer markets were reported for alcohol, tin salts, calcium arsenate, aniline oil and other, coal-tar chemicals. The weighted index number showed a gain of .26 points for the month and is higher than for the corresponding period of the two preceding years.

Market for Methanol Displays Firmer Tone

The fact that competition from German synthetic methanol has not been active has had a strengthening effect on the domestic market. The figures for crude methanol production in July are given as 880,196 gal. and for the three month period ended July, production was 2,645,626 gal. which compares with 2,081,807 for the preceding three months. Still greater increases in comparison with corresponding periods of 1925. A similar condition is found in the case of refined methanol with July production reaching a total of 685,201 gal. Recent advances in sales prices for methanol also may be regarded as signs of the improved condition of trade.

The latest available figures applying to importations of methanol into this country are for June. In that month only 20,436 gal. valued at $9,433 was imported. This is an average of slightly more than 46c. per gal. with the addition of 12c. per gal. import duty, the landed price would be fractionally over 58c. per gal.

In connection with the position of the wood chemical industry in Germany Consul H. C. Claiborne reports that due to the heavy competition from new processes of the I. G. Farbenindustrie A. G. permitting the manufacture of acetic acid and methyl alcohol by synthetic means, share owners of the Holzerkohlungs-Industrie A. G. as well as the press, have repeatedly raised the question whether it would be possible for the German wood distillation industry to maintain its activities, more particularly as the synthetic processes are based upon cheap raw materials. This question was also put in the business report of 1925 for the above concern, but no answer was given; the uncertainty prevailing as to the future of the concern therefore remains unchanged. Due to the competition by the I. G. Farbenindustrie, prices for products of the Holzverkohlungs - Industrie dropped notably, whereas quotations for raw material increased. An agreement is reported to have been made with the I. G. concerning the sales of both companies' products, but unfavorable circumstances demanded effective measures for a decrease of expenses. The sum of 877,000 marks was spent for an extension of the plants and in order to cover these extra expenses, bank credits had to be taken up to a certain extent. It is reported that the manufacture of wood alcohol has been abandoned by the plants of the concern at Hochspeyer and Biebrich.

Gain in Domestic Consumption of Vegetable Oils

Consumption of vegetable oils in the United States is characterized by a substantial increase in 1925 over that of 1924, with a steady increase apparent since 1922.

A report from the Foodstuffs Division at Washington says the increase in production of vegetable oils from 1912 to 1919 was 242,566,000 lb., but for some time subsequent to 1919 the production fell off considerably. However, since 1922 the quantity produced has been steadily increasing, with an annual production in 1925 of 2,642,904,000 lb., which is the largest in the history of the trade.

The crushing of peanuts and soya beans shows the largest percentage of increase. Prior to the war there were but 454,000 lb. of peanut oil produced in this country whereas in 1925 the amount was 15,852,000 lb. Soya bean oil production was of little consequence before 1922, most of the oil coming in from Manchuria and Japan. However, due to the campaign conducted to stimulate the cultivation of this nitrogenous crop as a soil rejuvenator, the growing of these beans has greatly increased and consequently the production of soya bean oil in this country on a small scale has been brought about. In 1925 there were produced 1,405,000 lb. of oil. The only oils which show a decrease in production are olive, palm kernel and rapeseed.

United States imports of vegetable oils while indicating an increase to 717,590,000 lb. in 1925 as compared with 577,890,000 lb. in 1924, have not attained the peak set by the importations of 1919 when they totaled 866,469,000 lb. There was a large increase from 1912 to 1919 but in 1921 the amount imported dropped to less than half of that of 1919. Cottonseed oil, has since 1923 ceased to be imported. Other important import reductions were in receipts of cocoa butter, castor oil, olive foots, and sulphur oil, and perilla oil. A sharp reduction in the imports of soya bean oil in 1924 was brought about by the short crop in Asia and the competition of other oils throughout the world.

Chem. & Met. Weighted Index of Prices for Oils and Fats

Base = 100 for 1913-14

This month	**154.26**
Last month	156.50
September, 1925	156.04
September, 1924	142.68

Lower prices ruled for cottonseed, linseed, china wood and oleo oils. Glycerine also was easier but palm oil, olive oil foots, and tallow closed at an advance. The weighted index number declined 2.24 points. Note—Through error incorrect index numbers were given in this box in our August issue. The numbers should have read: This month, 156.50; last month 164.71; August, 1925, 158.37; August, 1924, 149.02.

Bichromate of Soda Finds Larger Outlet in Export Trade

Although export shipments of chromate and bichromate of soda amounted to only 243,295 lb. valued at $15,381 in July as compared with 713,209 lb. valued at $42,565 in July, 1925, the totals for the seven months ended July were in excess of those for the corresponding period of 1925, the amounts being 4,260,724 lb. and 4,209,354 lb. respectively. These totals are given in the official returns of the Department of Commerce as applying chromate and bichromate of soda but it is stated that practically all of the exportations consist of bichromate. In the following table will be found an analysis of this export trade according to countries of destination. The figures cover the first five months of the current year. The largest foreign buyer of bichromate of soda is the United Kingdom with Japan holding second place. Canada ranks third, followed by the Netherlands. France, no longer, is a heavy buyer and the other countries enumerated are shown to have taken only moderate amounts.

Exports of Sodium Bichromate and Sodium Chromate
Jan.–May, 1926

Exported to	Lb.	Value	Average Value per Pound
United Kingdom	953,927	$57,601	$0.0603
Japan, including Chosen	710,955	43,505	.0611
Canada	537,456	23,194	.0617
Netherlands	448,000	26,880	.06
France	105,280	6,606	.0627
Italy	92,400	5,095	.0551
Mexico	86,100	4,975	.0577
Argentina	67,200	3,582	.0533
British South Africa	47,040	2,637	.0560
Spain	44,800	2,304	.0514
Sweden	44,800	2,688	.06
British India	33,600	1,794	.0533
Belgium	33,600	1,996	.0596
China	33,600	2,116	.0629
Denmark and Faroe Islands	22,400	1,344	.06
Brazil	22,400	1,220	.0544
Costa Rica	200	20	.10
Nicaragua	200	44	.22
Honduras	13	4	.3077

Current Prices in the New York Market

For Chemicals, Oils and Allied Products

The following prices refer to round lots in the New York Market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to September 13.

Industrial Chemicals

		Current Price	Last Month	Last Year
Acetone, drums	lb.	$0.12 -$0.13	$0.12 -$0.13	$0.12 -$0.13
Acid, acetic, 28%, bbl.	cwt.	3.25 - 3.50	3.25 - 3.50	3.00 - 3.25
Boric, bbl.	lb.	.09 - .10	.09 - .10	.08½ - .10
Citric, kegs	lb.	.44½ - .45	.44½ - .47	.45½ - .47
Formic, bbl.	lb.	.10½ - .11½	.10½ - .11	.10½ - .10½
Gallic, tech., bbl.	lb.	.50 - .55	.50 - .55	.45½ - .47
Hydrofluoric 30% carb.	lb.	.06 - .07	.06 - .07	.06½ - .07
Lactic, 44%, tech., light, bbl.	lb.	.13½ - .14	.13½ - .14	.13½ - .14
22%, tech., light, bbl.	lb.	.06½ - .07	.06½ - .07	.06½ - .07
Muriatic, 18°, tanks	cwt.	.80 - .85	.80 - .85	.80 - .85
Nitric, 36°, carboys	cwt.	.05 - .05½	.05 - .05½	.04½ - .04½
Oleum, tanks, wks.	ton	18.00 -20.00	18.00 -20.00	16.00 - 17.00
Oxalic, crystals, bbl.	lb.	.10½ - .11	.10½ - .11	.10½ - .11
Phosphoric, tech., c'bys.	lb.	.07 - .07½	.07 - .07½	.07½ - .08
Sulphuric, 60°, tanks	ton	10.50 -11.00	10.50 -11.00	8.50 - 9.50
Tannic, tech., bbl	lb.	.35 - .40	.35 - .40	.45 - .50
Tartaric, powd., bbl	lb.	.29 - .30	.29 - .30	.27½ - .30
Tungstic, bbl	lb.	1.00 - 1.20	1.00 - 1.20	1.20 - 1.25
Alcohol, ethyl, 190 p'f. U.S.P. bbl	gal.	4.75 - 4.80	4.90 - 5.00	4.90 -
Alcohol, Butyl, dr.	lb.	.19½ - .20½	.18 - .19	.27 - .30
Denatured, 190 proof No. 1 special dr	gal.	.31 - .36	.29 - .40	.54½ -
No. 5, 188 proof, dr.	gal.	.31 - .33	.29 - .32	.53½ -
Alum, ammonia, lump, bbl	lb.	.03½ - .04	.03½ - .04	.03½ - .04
Chrome, bbl	lb.	.05½ - .05½	.05½ - .05½	.05½ - .06
Potash, lump, bbl	lb.	.02½ - .03½	.02½ - .03½	.02½ - .03½
Aluminum sulphate, com., bags	cwt.	1.40 - 1.45	1.40 - 1.45	1.40 - 1.45
Iron free, bg	cwt.	2.00 - 2.10	2.00 - 2.10	2.40 - 2.45
Aqua ammonia, 26°, drums	lb.	.03½ - .04	.03½ - .04	.06 - .06½
Ammonia, anhydrous, cyl.	lb.	.13 - .15	.13 - .15	.28 - .30
Ammonium carbonate, powd. tech., casks	lb.	.08½ - .09	.07½ - .08½	.11 - .11½
Sulphate, wks.	cwt.	2.40 -	2.40 -	2.80 -
Amylacetate tech., drums	gal.	1.60 - 1.75	1.75 - 1.85	2.75 - 3.00
Antimony Oxide, bbl.	lb.	.16 - .16½	.16 - .16½	.16 - .16½
Arsenic, white, powd., bbl	lb.	.03½ - .04½	.03½ - .04½	.03½ - .04½
Red, powd., kegs	lb.	.10½ - .11	.11 - .11½	.12 - .12½
Barium carbonate, bbl.	ton	50.00 -52.00	55.00 -56.00	48.00 -50.00
Chloride, bbl.	ton	63.00 -65.00	63.00 -65.00	58.00 -60.00
Nitrate, casks	lb.	.07½ - .08	.07½ - .08½	.07½ - .08
Blanc fixe, dry, bbl	lb.	.03½ - .04	.03½ - .04	.03½ - .04
Bleaching powder, f.o.b., wks., drums	cwt.	2.00 - 2.10	2.00 - 2.10	1.90 -
Borax, bbl.	lb.	.05 - .05½	.05 - .05½	.05 - .05½
Bromine, cs.	lb.	.45 - .47	.45 - .47	.47 - .48
Calcium acetate, bags	cwt.	3.25 - 3.50	3.25 - 3.50	2.75 - 2.80
Arsenate, dr.	lb.	.08½ - .11	.06½ -	.07 - .08
Carbide drums	lb.	.05½ - .06	.05½ - .06	.05 - .05½
Chloride, fused, dr., wks.	ton	21.00 -	21.00 -	21.00 -
Phosphate, bbl.	lb.	.07 - .07½	.07 - .07½	.06½ - .07½
Carbon bisulphide, drums	lb.	.05½ - .06	.05½ - .06	.05 - .06
Tetrachloride drums	lb.	.06½ - .07	.06½ - .06½	.07 - .07½
Chlorine, liquid, tanks, wks.	lb.	.04 - .04½	.04 - .04½	.04 - .04½
Cylinders	lb.	.05½ - .08	.05½ - .08	.05½ - .08
Cobalt oxide, cans	lb.	2.10 - 2.20	2.10 - 2.20	2.10 - 2.25
Copperas, bgs., f.o.b. wks.	ton	16.00 -20.00	16.00 - 18.00	13.00 - 14.00
Copper carbonate, bbl.	lb.	.17 - .17½	.17 - .18	.16½ - .17
Cyanide, tech., bbl	lb.	.49 - .50	.49 - .50	.49 - .50
Sulphate, bbl.	cwt.	4.75 - 5.00	4.90 - 4.95	4.50 - 4.60
Cream of tartar, bbl.	lb.	.21 - .22	.21 - .22	.21½ - .22
Epsom salt, dom., tech., bbl.	cwt.	1.75 - 2.15	1.75 - 2.00	1.75 - 2.00
Imp., tech., bags	cwt.	1.15 - 1.25	1.30 - 1.40	1.35 - 1.40
Ethyl acetate, 85% drums	gal.	.74 - .76	.80 - .82	.87 - .90
99%, dr.	gal.	.95 - .96	1.01 -	1.03 - 1.06
Formaldehyde, 40%, bbl	lb.	.10½ - .17½	.10½ - .10½	.08½ - .09
Furfural, dr.	lb.	.15 - .17½	.15 - .17½	.23 -
Fusel oil, crude, drums	gal.	1.35 - 1.40	1.40 - 1.50	2.40 - 2.50
Refined, dr	gal.	2.50 - 3.00	2.50 - 3.00	3.25 - 3.50
Glaubers salt, bags	cwt.	1.00 - 1.15	1.00 - 1.10	1.20 - 1.40
Glycerine, c.p., drums, extra	lb.	.29 - .30	.30 - .32	.19 - .19½
Lead: White, basic carbonate, dry, casks	lb.	.10½ -	.10½ -	.10½ -
White, basic sulphate, sck.	lb.	.13 -	.10 -	.10 -
Red, dry, sck	lb.	.12 -	.12 -	.12½ -
Lead acetate, white crys., bbl.	lb.	.14½ - .15	.14½ - .15	.14½ -
Lead arsenate, powd., bbl	lb.	.14 - .15	.14 - .15	.13 - .14
Lime, chem., bulk	ton	8.50 -	8.50 -	8.50 -
Litharge, pwd., csk	lb.	.11½ -	.11½ -	.12 -
Lithopone, bags	lb.	.05½ - .06	.05½ - .06	.06 - .06½
Magnesium carb., tech., bags.	lb.	.06½ - .06½	.06½ - .06½	.06½ - .07
Methanol, 95%, dr	gal.	.68 - .70	.65 - .68	.58 - .62
97%, dr.	gal.	.70 - .72	.67 - .72	.60 - .64
Nickel salt, double, bbl.	lb.	.10 - .10½	.10 - .10½	.09 - .10
Single, bbl.	lb.	.10½ - .11	.10½ - .11	.10 - .11
Orange mineral, csk.	lb.	.14½ -	.14½ -	.16 -
Phosphorus, red, cases	lb.	.62 - .65	.62 - .65	.70 - .75
Yellow, cases	lb.	.32 - .33	.32 - .34	.34 - .36
Potassium bichromate, casks.	lb.	.08½ - .08½	.08½ - .08½	.08½ - .08½
Carbonate, 80-85%, calc., csk.	lb	.05½ - .06	.06 -	.06 - .06½
Chlorate, powd.	lb.	.08½ - .09	.08½ - .09	.08½ - .09
Cyanide, cs.	lb.	.55 - .57	.55 - .58	.47 - .62
First sorts, csk.	lb.	$0.09 -$0.09½	$0.08½-$0.09	$0.08½-$0.08½
Hydroxide(c'stic potash) dr.	lb.	.07½ - .07½	.07½ - .07½	.07½ - .07½
Muriate, 80% bgs.	ton	34.90 -	34.90 -	34.55 -
Nitrate, bbl.	lb.	.06 - .06½	.06½ - .06½	.06 - .07½
Permanganate, drums	lb.	.14 - .15	.14½ - .15	.14½ - .15
Prussiate, yellow, casks	lb.	.18½ - .18½	.18½ - .18½	.18½ - .18½
Sal ammoniac, white, casks.	lb.	.05½ - .06	.05½ - .06½	.05½ - .06
Salsoda, bbl.	cwt.	.90 - .95	.85 - .95	1.10 - 1.20
Salt cake, bulk	ton	17.00 -18.00	17.00 -18.00	17.00 -19.00
Soda ash, light, 58%, bags, contract	cwt.	1.38 -	1.38 -	1.38 -
Dense, bags	cwt.	1.45 - 1.55	1.45 - 1.55	1.45 - 1.55
Soda, caustic, 76%, solid, drums, contract	cwt.	3.10 -	3.10 -	3.10 -
Acetate, works, bbl.	lb.	.04½ - .05½	.04½ - .05	.04½ - .05
Bicarbonate, bbl.	cwt.	2.00 - 2.25	2.00 - 2.25	1.75 - 2.00
Bichromate, casks	lb.	.06½ - .06½	.06½ - .06½	.06½ - .06½
Bisulphate, bulk	ton	5.00 - 5.50	5.00 - 5.50	6.00 - 7.00
Bisulphite, bbl.	lb.	.03½ - .04	.03½ - .04	.04½ - .04½
Chlorate, kegs	lb.	.06½ - .06½	.06½ - .06½	.06½ - .06½
Chloride, tech.	ton	12.00 -14.75	12.00- 14.75	12.00 -14.00
Cyanide, cases, dom.	lb.	.18 - .22	.18 - .22	.19 - .22
Fluoride, bbl.	lb.	.09 - .09½	.08½ - .09	.09 - .09½
Hyposulphite, bbl.	lb.	2.50 - 3.00	2.50 - 3.00	.02½ - .02½
Nitrate, bags	cwt.	2.36 -	2.34 -	2.50 -
Nitrite, casks	lb.	.08½ - .09½	.08½ - .09	.09 - .09½
Phosphate, dibasic, bbl.	lb.	.03½ - .03½	.03½ - .03½	.03½ - .03½
Prussiate, yel. drums	lb.	.10½ - .10½	.10½ - .10½	.10½ - .10½
Silicate (30°, drums)	cwt.	.75 - 1.15	.75 - 1.15	.75 - 1.15
Sulphide, fused, 60-62%, dr.	lb.	.03 - .03½	.03 - .03½	.02½ - .03
Sulphite, crys., bbl.	lb.	.03 - .03½	.03 - .03½	.02½ - .03
Strontium nitrate, bbl.	lb.	.08½ - .09	.08½ - .09	.09½ - .10
Sulphur, crude at mine, bulk.	ton	19.00 -	19.00 -	15.00 -16.00
Chloride, dr.	lb.	.05 - .05½	.05 - .05½	.04½ - .05
Dioxide, cyl.	lb.	.09 - .10	.09 - .10	.08½ - .09
Flour, bag	cwt.	2.70 - 3.00	2.70 - 3.00	2.25 - 2.35
Tin bichloride, bbl.	lb.	.19 -	.17½ -	.16 -
Oxide, bbl.	lb.	.67 -	.66 -	.60 -
Crystals, bbl.	lb.	.45½ -	.43 -	.39½ -
Zinc chloride, gran., bbl.	lb.	.07 - .07½	.07 - .08	.06 - .07½
Carbonate, bbl.	lb.	.11 - .11½	.11 - .11½	.12 - .14
Cyanide, dr.	lb.	.40 - .41	.40 - .41	.40 - .41
Dust, bbl.	lb.	.09 - .10	.09 - .10	.08 - .08½
Zinc oxide, lead free, bag.	lb.	.07½ -	.07½ -	.07½ -
5% lead sulphate, bags.	lb.	.07 -	.07 -	.06½ -
Sulphate, bbl	cwt.	2.75 - 3.00	2.75 - 3.00	3.50 - 3.75

Oils and Fats

		Current Price	Last Month	Last Year
Castor oil, No. 3, bbl.	lb.	$0.12½-$0.13	$0.11½-$0.12	$0.16½-$0.17
Chinawood oil, bbl.	lb.	.16½ -	.18 -	.13½ - .14
Coconut oil, Ceylon, tanks, N. Y.	lb.	.10 -	.10 -	.11 -
Corn oil crude, tanks, (f.o.b. mill)	lb.	.10½ -	.10½ -	.09½ -
Cottonseed oil, crude (f.o.b. mill), tanks	lb.	.10½ -	.11 -	.09 -
Linseed oil, raw, car lots, bbl.	lb.	11.4 -	12.3 -	14.0 -
Palm, Lagos, casks	lb.	.08½ - .09	.08½ - .9½	.09 -
Niger, casks	lb.	.08½ -	.08½ -	.08 -
Palm Kernel, bbl.	lb.	.10½ -	.10½ - .11	.09½ -
Peanut oil, crude, tanks (mill)	lb.	.12½ -	.13 -	.09½ -
Perilla, bbl	lb.	-	.15 - .15½	.14½ -
Rapeseed oil, refined, bbl.	gal.	.85 - .86	.92 - .94	1.00 - 1.02
Sesame, bbl.	lb.	-	-	.15 - .15½
Soya bean tank (f.o.b. Coast)	lb.	.10½ -	.10½ -	.11½ -
Sulphur (olive foots), bbl.	lb	.08½ -	.08 -	.08½ -
Cod, Newfoundland, bbl	gal.	.62 - .65	.62 - .65	.62 - .63
Menhaden, light pressed, bbl.	gal.	.63 - .67	.65 - .67	.76 - .78
Crude, tanks (f.o.b. factory)	gal.	.47½ - .50	.47½ -	.50 -
Whale, crude, tanks	lb.	-	-	-
Grease, yellow, loose	lb.	.08 -	.07½ -	.09 - .09½
Oleo stearine	lb.	.12 -	.11½ -	.13½ -
Red oil, distilled, d.p. bbl.	lb.	.10 - .10½	.10 - .10½	.11½ - .11½
Tallow, extra, loose	lb.	.08½ -	.08 -	.09½ -

Coal-Tar Products

		Current Price	Last Month	Last Year
Alpha-naphthol, crude, bbl	lb.	$0.60 -$0.65	$0.60 -$0.65	$0.60 -$0.62
Refined, bbl	lb.	.85 - .90	.85 - .90	.75 - .80
Alpha-naphthylamine, bbl.	lb.	.35 - .36	.35 - .36	.35 - .36
Aniline oil, drums, extra	lb.	.16 - .17	.16 - .16½	.17 - .17½
Aniline salts, bbl	lb.	.22 - .24	.20 - .22	.20 - .22
Anthracene, 80%, drums	lb.	.60 - .65	.60 - .65	.65 - .70
Benzaldehyde, U.S.P., dr.	lb.	1.15 - 1.25	1.15 - 1.35	1.50 -
Benzidine base, bbl.	lb.	.70 - .72	.70 - .75	.78 - .80
Benzoic acid, U.S.P., kgs.	lb.	.58 - .60	.58 - .60	.75 - .85
Benzyl chloride, tech, dr.	lb.	.25 - .26	.25 - .26	.35 - .36
Benzol, 90%, tanks, works	gal.	.25 - .28	.25 - .28	.24 - .25
Beta-naphthol, tech., drums	lb.	.22 - .24	.22 - .24	.24 - .25
Cresol, U.S.P., dr.	lb.	.18 - .20	.18 - .20	.23 - .25
Cresylic acid, 97%, dr., wks	gal.	.59 - .65	.59 - .63	.59 - .62
Diethylaniline, dr	lb.	.58 - .60	.58 - .60	.59 - .61
Dinitrophenol, bbl.	lb.	.31 - .35	.31 - .33	.35 - .38
Dinitrotoluen, bbl.	lb.	.17 - .18	.17 - .18	.18 - .20
Dip oil; 25% dr.	gal.	.28 - .30	.28 - .30	.26 - .28
Diphenylamine, bbl.	lb.	.45 - .47	.48 - .50	.48 - .50
H-acid, bbl.	lb.	.63 - .65	.63 - .65	.70 - .74

Coal-Tar Products—Continued

		Current Price	Last Month	Last Year
Naphthalene, flake, bbl.	lb.	$0.05½-$0.06	$0.05½-$0.06	$0.05 -$0.05½
Nitrobenzene, dr.	lb.	.09 - .10	.09 - .10	.09 - .10
Para-nitraniline, bbl.	lb.	.45 - .48	.45 - .50	.65 - .67
Para-nitrotoluine, bbl.	lb.	.28 - .32	.28 - .32	.40 - .42
Phenol, U.S.P., drums	lb.	.17 - .19	.17 - .19	.22 - .24
Picric acid, bbl.	lb.	.30 - .40	.30 - .40	.25 - .26
Pyridine, dr.	lb.	4.10 -.....	4.10 -.....	4.10 - 4.20
R-salt, bbl.	lb.	.47 - .50	.40 - .44	.50 - .55
Resorcinal, tech, kegs	lb.	1.30 - 1.35	1.35 - 1.40	1.30 - 1.40
Salicylic acid, tech., bbl.	lb.	.30 - .32	.30 - .32	.32 - .33
Solvent naphtha, w.w.,tanks	gal.	.35 -.....	.35 -.....	.26 - .26
Tolidine, bbl.	lb.	.95 - .95	.95 - .96	1.00 - 1.05
Toluene, tanks, works	gal.	.35 -.....	.35 -.....	.26 -.....
Xylene, com., tanks	gal.	.36 - .41	.36 - .41	.26 - .27

Miscellaneous

		Current Price	Last Month	Last Year
Barytes, grd., white, bbl.	ton	$23.00-$25.00	$23.00-$25.00	$20.00-$22.00
Casein, tech., bbl.	lb.	.16½- .16¾	.16½- .18½	.13 - .14
China clay, powd., f.o.b. Va.	ton	10.00 -20.00	10.00 -20.00	10.00 -20.00
Imported, powd.	ton	45.00 -50.00	45.00 -50.00	45.00 -50.00
Dry colors:				
Carbon gas, black (wks.)	lb.	.08 - .08½	.08 - .08½	.07 - .07½
Prussian blue, bbl.	lb.	.32 - .33	.32 - .34	.34 - .36
Ultramine blue, bbl.	lb.	.08 - .35	.08 - .35	.08 - .35
Chrome green, bbl.	lb.	.28 - .30	.28 - .30	.27 - .29
Carmine red, tins	lb.	5.00 - 5.10	5.00 - 5.10	4.50 - 4.75
Para toner	lb.	.85 - .90	.90 - .95	.90 - .95
Vermilion, English, bbl.	lb.	1.45 - 1.50	1.45 - 1.50	1.35 - 1.40
Chrome yellow, C. P., bbl.	lb.	.17 - .18	.17½- .18	.18 - .19
Feldspar, No. 1 (f.o.b. N. C.)	ton	5.50 - 6.50	6.00 - 6.50	5.50 - 6.00
Graphite, Ceylon, lump, bbl.	lb.	.07 - .09½	.07 - .09½	.08½- .09
Gum copal, Congo, bags	lb.	.09½- .10	.09½- .10	.08 - .10
Manila, bags	lb.	.15 - .18	.15 - .16	.14 - .16
Damar, Batavia, cases	lb.	.25 - .25½	.25 - .26	.28½- .28¾
Kauri, No. 1 cases	lb.	.55 - .57	.57 - .65	.58 - .62
Kieselguhr (f.o.b. N. Y.)	ton	50.00 -55.00	50.00 -55.00	50.00 -55.00
Magnesite, calc.	ton	44.00 -.....	44.00 -.....	40.00 -41.00
Pumice stone, lump, bbl.	lb.	.05 - .07	.05 - .08	.06 - .08
Imported, casks	lb.	.03 - .40	.03 - .40	.03 - .35
Rosin, H.	bbl.	15.85 -.....	14.15 -.....	11.50 -.....
Turpentine	gal.	.93 -.....	.98 -.....	.98 -.....
Shellac, orange, fine, bags	lb.	.36 - .37	.29 - .30	.52 - .53
Bleached, bonedry, bags	lb.	.36 - .40	.36 - .40	.59 - .62
T. N. bags	lb.	.34 - .35	.27 - .28	.49 - .51
Soapstone (f.o.b. Vt.), bags	ton	10.00 -12.00	10.00 -12.00	9.00 -11.00
Talc, 200 mesh (f.o.b. Vt.)	ton	11.00 -.....	11.00 -.....	10.50 -.....
200 mesh (f.o.b. Ga.)	ton	7.50 -10.00	7.50 -10.00	7.50 -11.00
325 mesh (f.o.b. N. Y.)	ton	14.75 -.....	14.75 -.....	14.75 -.....
Wax, Bayberry, bbl.	lb.	.31 - .35	.21 - .22	.20 - .21
Beeswax, ref., light	lb.	.45 - .46	.47 - .48	.40 - .42
Candelilla, bags	lb.	.34 - .35	.34 - .35	.30 - .31
Carnauba, No. 1, bags	lb.	.56 - .58	.50 - .51	.37 - .38
Paraffine, crude 105-110 m.p.	lb.	.05½- .06	.06 - .06¼	.06 -.....

Ferro-Alloys

		Current Price	Last Month	Last Year
Ferrotitanium, 15-18%	ton	$200.00-.....	$200.00-.....	$200.00-.....
Ferrochromium, 1-2%	lb.	.23- .25	.23- .35	.24-.....
Ferromanganese, 78-82%	ton	88.00-90.00	88.00-90.00	115.00-.....
Spiegeleisen, 19-21%	ton	32.00-34.00	32.00-34.00	32.00-.....
Ferrosilicon, 10-12%	ton	33.00-38.00	33.00-38.00	39.50-43.00
Ferrotungsten, 70-80%	lb.	1.05-.....	.95- 1.15	.90- ...
Ferro-uranium, 35-50%	lb.	4.50-.....	4.50-.....	4.50-.....
Ferrovanadium, 30-40%	lb.	3.40- 4.00	3.25- 4.00	3.25- 3.75

Non-Ferrous Metals

		Current Price	Last Month	Last Year
Copper, electrolytic	lb.	$0.14¼-.....	$0.14¼-.....	$0.14¼-$0.15¼
Aluminum, 96-99%	lb.	.27 - .28	.27 - .28	.27 - .28
Antimony, Chin. and Jap.	lb.	.15 - .15½	.15½- .16	.20½-.....
Nickel, 99%	lb.	.35 -.....	.35 -.....	.31 - .32
Monel metal, blocks	lb.	.32 - .33	.32 - .33	.32 - .33
Tin, 5-ton lots, Straits	lb.	.68½-.....	.64½-.....	.57½-.....
Lead, New York, spot	lb.	8.75 -.....	8.40 -.....	.09 -.....
Zinc, New York, spot	lb.	7.80 -.....	7.65 -.....	.07½-.....
Silver, commercial	oz.	.63½-.....	.63½-.....	.63½-.....
Cadmium	lb.	.60 -.....	.60 -.....	.60 -.....
Bismuth, 508-lb. lots	lb.	2.70 - 2.75	2.70 - 2.75	1.30 - 1.35
Cobalt	lb.	2.50 -.....	3.00 -.....	2.50 - 3.00
Magnesium, ingots, 99%	lb.	.75 - .80	.75 - .80	.90 - .95
Platinum, ref.	oz.	116.00-.....	112.00-.....	117.00-.....
Palladium, ref.	oz.	68.00- 70.00	69.00- 71.00	78.00-.....
Mercury, flask..... 75	lb.	90.00-.....	90.50-.....	79.00-80.00
Tungsten powder	lb.	1.10- 1.15	1.10-.....	.95- 1.00

Ores and Semi-finished Products

		Current Price	Last Month	Last Year
Bauxite, crushed, wks.	ton	$5.50- $8.50	$5.50- $8.50	$5.50- $8.75
Chrome ore, c.f. post	ton	22.50- 25.00	22.50- 24.00	18.50- 24.00
Coke, fdry., f.o.b. ovens	ton	3.75- 4.25	3.75- 4.25	4.75- 5.00
Fluorspar, gravel, f.o.b. Ill.	ton	18.00-.....	18.00-.....	17.50- 18.50
Ilmenite, 52% TiO_2, Va.	lb.	.01½-.....	.01½-.....	.01½-.....
Manganese ore, 50% Mn., c.i.f. Atlantic Ports	unit	.40 - .36	.35 - .36	.42 - .43
Molybdenite, 85% MoS_2 per lb. MoS_2, N. Y.	lb.	.50 - .55	.50 - .55	.60- .70
Monazite, 6% of ThO_2	ton	120.00-.....	120.00-.....	120.00-.....
Pyrites, Span. fines, c.i.f.	unit	.13½-.....	.13½-.....	.11½- .12
Rutile, 94-96% TiO_2	lb.	.12 - .15	.12 - .15	.12 - .15
Tungsten, scheelite, 60% WO_3 and over	unit	12.50 -13.00	12.50 -13.00	9.50 - 9.75
Vanadium ore, per lb. V_2O_5	lb.	.30 - .35	.30 - .35	1.00 - 1.27
Zircon, 99%	lb.	.03 -.....	.03 -.....	.06 - .05

Hankow Shipments of Wood Oil in August

Exports of wood oil from Hankow, China, during August totaled 8,843,100 lb., of which 7,106,500 lb. were shipped to the United States, practically all of the remainder going to Europe, according to a report from the consul general at Hankow, China. Wood oil prices in Hankow continued their July increase to a high point of 32 taels per picul on August, falling shortly afterward to 29 taels and declining slowly, due to an increase in foreign demand, to 25 taels (13⅓ cents per pound) per picul at the end of the month, with stocks on hand of 100 tons.

Decrease in Stocks of Hides and Sole Leather

The total number of cattle hides in stock July 31 was 4,267,609 compared with 4,426,469 on June 30, according to reports to the Department of Commerce. Stocks of calf and kid skins amounted to 4,446,448 compared with 4,100,650; goat and kid skins, 11,557,697 compared with 10,271,888, and sheep and lamb skins 7,466,975 compared with 7,087,632 on June 30. Total stocks of sole leather (cattle) amounted to 4,998,068 backs, bends and sides on July 31 against 5,266,874 on June 30.

Production of sole leather during July amounted to 1,114,708 pieces and stocks in process at end of month to 4,394,999.

Sulphur Company Will Prospect In Texas

Freeport Texas Co. has leased the sulphur rights on the Allen Dome, about ten miles from Freeport, Texas, from the Roxana Petroleum Co. One well drilled in search of oil shows very good sulphur, and other wells will be drilled in the near future. The dome is on a river assuring ample water supply for mining operations.

Chemists Oppose Increased Mileage Rates on Tank Cars

The Manufacturing Chemists Association has served notice that it will oppose any increase in the empty mileage charge on tank cars in eastern territory. A determined effort is being made to secure a reduction in the eight cent and nine cent rates in effect in the West and the South, respectively. The East enjoys a six cent rate. The Manufacturing Chemists are particularly anxious that there be no disturbance of that rate. The suggestion has been made that better rates could be extended the West and the South by increasing the eastern rate.

Petroleum Production Gained Last Year

The world's production of petroleum in 1925 amounted to 1,067,566,000 barrels of 42 U. S. gallons each, as compared with 1,013,623,000 barrels in the preceding year, according to a tabulation just issued by the Department of Commerce.

The United States lead the world in the production, her share in 1925 amounting to 763,743,000 bbl. as compared with 713,940,000 bbl. in 1924.

Notable increases in output are shown for the United States and Venezuela, while Mexico, the next largest producer, registered a decrease.

The United States' production of petroleum increased about 50,000,000 bbl. over 1924; Venezuela's output increased more than 10,000,000 bbl., while Mexico's output declined approximately 25,000,000 bbl. under 1924. Most other countries showed increases.

H. V. Walker Resigns Presidency of Miner-Edgar Co.

H. V. Walker, formerly president of the Maas & Waldstein Co. and more recently president of the Miner-Edgar Co., has resigned from the latter company and it is reported that his interests in the company have been acquired by Philip Publicker of Philadelphia.

Current Industrial Developments

New Construction and Machinery Requirements

New England

Mass., Cambridge—J. W. Greer Co., 119 Windsor St., awarded contract for the construction of 2 story, 65 x 80 ft. plant for manufacture of confections, on Windsor St., to Scully Co., 118 First St. Estimated cost $40,000.

Mass., Dorchester (Br. Boston)—Knox & Morse Co., 140 Oliver St., Boston, is having revised plans prepared for the construction of 2 story, 75 x 100 ft. shellac factory, at 70 Freeport St., here. Estimated cost $75,000. E. L. Rawson, 6 Beacon St., Boston, is architect. Owners will purchase machinery and equipment.

Mass., Forest Hills (mail Boston)—Harvard University, c/o Stevens & Lee, 45 Newbury St., Boston, Archts., soon awards contract for the construction of a 2 story, 45 x 75 ft. antitoxin laboratory, here. Estimated cost $50,000.

Mass., Mayard—Cellulose Products, Inc., c/o American Powder Mills, Acton, J. T. Barron, Pres., plans the construction of lacquer and cotton purifying plants, here. Estimated cost $40,000. Private plans. Owner will purchase chemical equipment.

Middle Atlantic

N. Y., Buffalo — Great Lakes Portland Cement Co., 999 Hamburg Turnpike, is having plans prepared for the construction of cement plant. Estimated cost $100,000. Private plans.

N. Y., Hornell—Hornell Gas Light Co. awarded contract for the construction of artificial gas manufacturing plant, containers, etc. J. B. Bradley, is superintendent.

N. Y., Johnson City—Endicott Johnson Corporation will build 1 story, 90 x 340 ft. building, including two 10 ton rubber reclamation plants, here. Estimated cost $350,000. Work will be done by Johnson City Service Dept. of company. C. F. Johnson, Jr., is general manager.

N. Y., Kings Park—State Hospital Commission, State Capitol, Albany will receive bids until September 29, for the construction of laboratory, etc., at Kings Park State Hospital, here.

N. Y., Pavilion—Genese Valley Gas Co., Mount Morris, is negotiating for the purchase of the Pavilion Natural Gas Co., and plans constructing artificial gas manufacturing plant, with complete equipment, here. Estimated cost $100,000. R. C. Burdick is engineer.

Pa., New Castle—Johnson Bronze Co., is having plans prepared for the construction of 1 and 2 story, foundry and pattern shop. Estimated cost $75,000. H. K. Ferguson Co., St. Clair and East 106th Sts., Cleveland, O., is engineer.

Pa., Philadelphia—Belmont Packing & Rubber Co., c/o contractor awarded contract for the construction of 2 story, 80 x 130 ft. manufacturing plant, at Sepviva and Biblin Sts., to G. Kessler Constr. Co., 1735 North Mervine St. Estimated cost $50,000.

Pa., Philadelphia—Dairy Maid Confectionery Co., 4925 North Broad St., awarded contract for the construction of 1 story, 50 x 2031 ft. manufacturing plant at 8th and Duncannon Sts., to W. Stelle & Sons Co., 219 North Broad St. Estimated cost $50,000.

Pa., Philadelphia—Schletz and Zander, Tulip and Rhawn Sts., awarded contract for the construction of 1 story, 30 x 64 ft. and 32 x 35 ft. dye house, to W. F. Lotz, 4644 Frankford Ave.

Pa., Philadelphia—H. W. Wilson, Engr., Peoples Bank Bldg., is receiving sub-bids for the construction of a 2 story, 60 x 83 ft. dyers' and finishers' plant, at Lippincott and 2nd Sts., to J. R. Foster & Son, 3100 North 2nd St.

Pa., Philadelphia — Yarnall Paint Co., 55th and Grays Ave., awarded contract for the construction of 3 story manufacturing plant, at 55th and Grays Aves., to W. Steele & Son, 219 North Broad St. Estimated cost $100,000.

South

Ala., Mobile—W. B. Patterson Clay Co., 1st National Bank plans rebuilding plant, 150,000 brick and 250 tons hollow tile daily capacity, at Rendell. F. L. Sayner, is in charge of construction.

Ga., Atlanta—Corrugated Paper Co., 73 Stephens St., awarded contract for the construction of addition to plant here, to the Massell Constr. Co.

Ga., Brunswick — Pan-American Petroleum Co. plans the construction of plant, including warehouse, 2 storage tanks, etc. on K St.

Ga., Sandersville — Georgia Portland Cement Co., Augusta, recently organized, plans the construction of a new mill, here. Estimated cost $1,750,000. J. L. Hankinson, 856 Georgia Ave., Augusta, is president.

Tenn., Cowan — Cumberland Portland Cement Co., Cumberland, Md., awarded contract for the construction of 2,000 bbl. portland cement plant here, to Kaucher Hodges, Shrine Bldg., Memphis.

Middle West

Mich., Holly — New Egyptian Portland Cement Co., 2306 Port Huron St., Port Huron, plans the construction of cement plant, near Rappalle, Allen & Lacey Lakes, here. Architect not selected. J. A. Acker, 2306 State St., Port Huron, is construction superintendent.

O., Akron—India Tire & Rubber Co., Mogadore St. is having plans prepared for 2 story, 38 x 80 ft. addition to factory, here. Estimated cost $45,000 to 50,000.

O., Cleveland—Willard Storage Battery Co., R. C. Nordberg, Vice Pres., and Genl. Mgr., 246 East 131st St., awarded contract for the construction of 4 story, 135 x 200 ft. factory, on Taft Ave., to H. K. Ferguson Co., 4900 Euclid Ave. Estimated cost $250,000.

O., Willoughby—Ohio Rubber Co. awarded contract for the construction of 1 story, 40 x 80 ft. factory, to G. A. Rutherford Co., 2725 Prospect Ave., Cleveland. Estimated cost $40,000.

Wis., Fond du Lac—Galloway-West Co., Tomkins St., awarded contract for the construction of 2 story, 56 x 98 ft. dry milk plant, on Tomkins St. to Tallmadge Constr. Co., 214 Mason, Milwaukee. Estimated cost $45,000.

Wis., Kohler—Kohler Co. awarded contract for the construction of a 3 story 132 x 600 ft. and 1 story 328 x 340 ft. pottery plant to Immel Constr. Co., Dana Bldg., Fond du Lac. Estimated cost $1,000,000.

Wis., Madison—Board of Regents, State University, is having plans prepared for the construction of 4 story, 40 x 200 ft. addition to chemistry building at State University, here. Estimated cost $250,000. A. Peabody, State Capitol, is state architect.

Wis., Milwaukee — A. F. Gallun & Sons Co., 1000 North Water St., will build 1 story, 90 x 120 ft. addition to tannery, by day labor. Estimated cost $40,000.

Wis., West Bend—West Bend Aluminum Co. awarded contract for the construction of 1 and 3 story, 98 x 192 ft. addition to factory, here, to W. F. Tubesing Co., 373 Broadway, Milwaukee.

West of Mississippi

Ark., El Dorado—Lion Oil Refining Co., H. M. Briedenthal, Vice-Pres., is having plans prepared for the 1st unit of plant for the manufacture of mineral rubber. Estimated cost $125,000.

Colo., Denver — J. F. Dennison, et al., plans the construction of modern clay products plant, on 15 acre tract, at Denver and Intermountain R.R. tracks west of here. Estimated cost $250,000.

Ia., Davenport — The Dewey Portland Cement Co., 301 Mutual Bldg., Kansas City, awarded contract for general construction of group of buildings for portland cement plant, here, to Priester Constr. Co., Kahl Bldg., Davenport.

Minn., Minneapolis — Minnesota Linseed Oil Plant Co., V. Wurtele, Vice Pres. and Treas., awarded contract for the construction of 1½ story, 153 x 150 ft. addition to factory, 3rd St. and 11th Ave., S., to J. Leck Co., 211 South 11th St. Estimated cost $100,000.

Kan., Wichita—Golden Rule Refining Co., 120 West 1st St., awarded contract for installing 1,000 bbl. unit Jenkins Cracking Process at refinery, here, to Graver Corp., East Chicago, Ind.

Tex., Houston—Trinity Portland Cement Co., c/o C. E. Ulrickson, genl. mgr. Santa Fe Bldg., Dallas, will build 1,800 bbl. daily capacity, portland cement plant with grinding rooms, packing house, laboratory, etc., at New York and Upper Ship Channel. Estimated cost $2,000,000.

Tex., Panhandle—Skelly Oil Co., Tulsa, will build eight 50 x 300 ft. natural gasoline plants including electric welded storage tanks, oil and charcoal process plants, etc. Work will be done by day labor. Estimated cost $400,000.

Tex., Port Arthur — Gulf Refining Co., Frick Bldg., Pittsburgh, Pa., plans enlarging oil refinery, here, including installing high pressure stills and auxiliary equipment.

Okla., Garber — Garber Refining Co. awarded contract for installing 1,000 bbl. unit Jenkins Cracking Process, at refinery, to Graver Corp., East Chicago, Ind.

Okla., Oklahoma City—Red Seal Refining Co., is having preliminary plans prepared for the construction of 4 still cracking gasoline plant, here. Estimated cost $150,000. F. C. Young, Oklahoma City, is engineer.

Far West

Calif., Fresno—Yosemite Portland Cement Co. plans the construction of cement mill, here. A. E. Wishon, c/o San Joaquin Light & Power Corp., to increase capital from $3,000,000 to $3,500,000.

Calif., Pittsburgh—Pioneer Rubber Co., 353 Sacramento St., San Francisco, will soon receive bids for the construction of 1 story, 110 x 250 ft. factory, here. Estimated cost $100,000. B. G. McDougall, 353 Sacramento St., San Francisco, is architect.

Calif., San Francisco — Royal Tallow Works, 1260 Davidson Ave., is having plans prepared for the construction of tallow works on Davidson Ave. Estimated cost $60,000.

Wash., Bellingham—Pacific Coast Paper Mills awarded contract for the construction of 2 story, 50 x 250 ft. addition to plant here, to Puget Sound Bridge & Dredging Co., Central Bldg., Seattle. Estimated cost $175,000.

Wash., Midwood—Inland Empire Paper Co. plans expanding plant and installing additional machinery in digester division and grinding department, for production of pulp, etc. Estimated cost $350,000.

Canada

Alta., Calgary—P. H. Grota, Long Beach, Calif, plans the construction of an absorption plant, for petroleum industry, here.

B. C., Westminister—W. H. Watron, Vancouver, plans the construction of a sugar beet factory, here. Estimated cost $1,250,000.

Ont., Almonte—Ottawa Dairy Co., Ltd., Somerset St., Ottawa, is in the market for equipment for new plant here, for manufacture of dried milk, casein and other milk products.

Ont., Midland—International Fibreboard Co. plans the construction of plant, recently destroyed by fire. Estimated cost $100,000. Owners will purchase complete equipment.

Que., Cap-de-la-Madeleine—St. Maurice Valley Corp., is in the market for digester, for pulp mill, here.

Sask., Regina—Imperial Oil Co. plans the construction of additions to plant and installation of new equipment. Estimated cost $500,000.